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SCIENCE FICTION AND FACT

OCTOBER 1996

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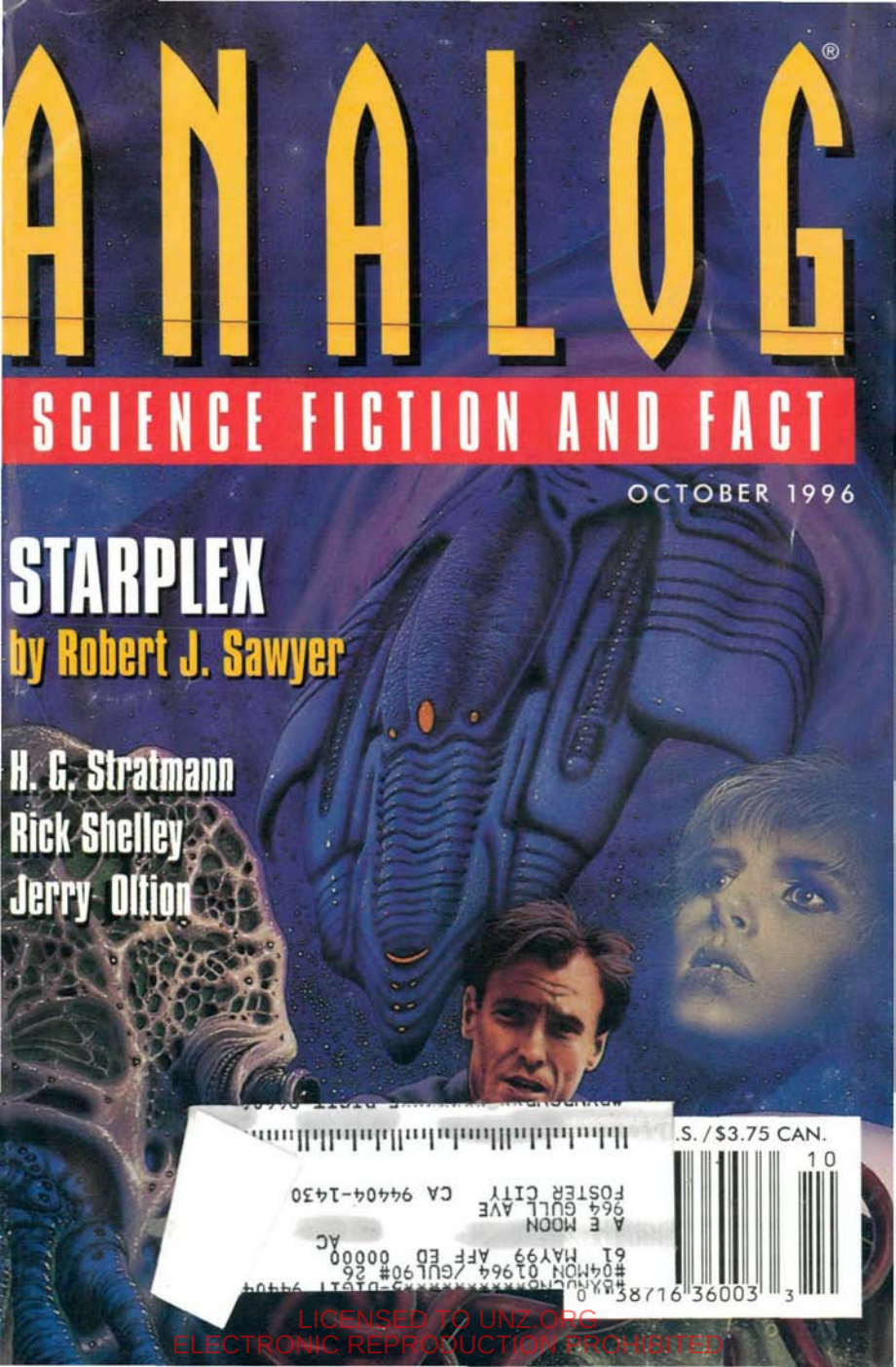

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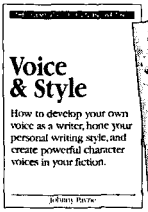
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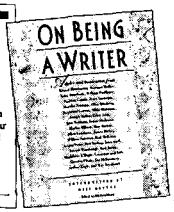

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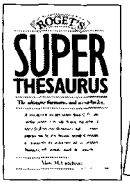

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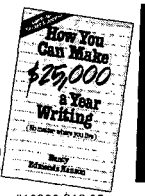

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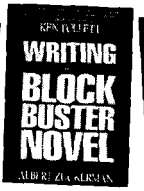

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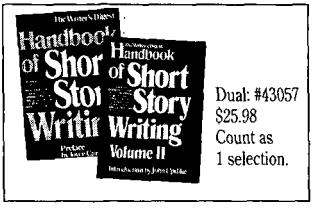

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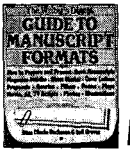

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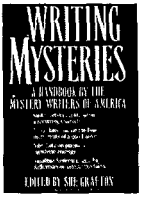

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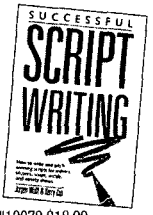

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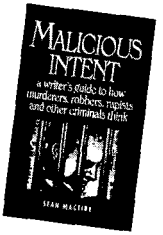

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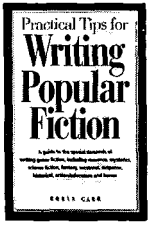

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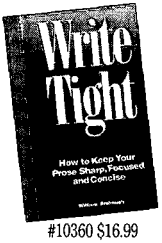

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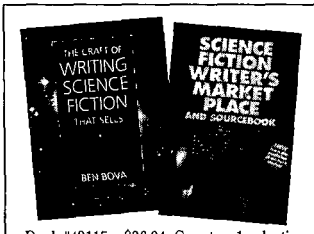

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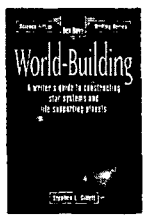

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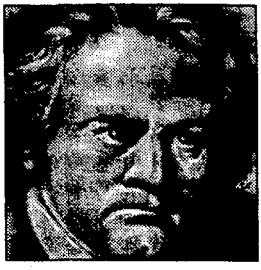

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"Daren't read *Blameless* until I've finished —may steal too many ideas..."

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HARCOURT BRACE

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THE FOREVER FALLACY

When I was growing up, I sometimes heard an adult on the radio or on a stage speak solemnly of "the everlasting hills." If you were like me, this probably struck you as carrying poetic license a bit far. Even as a child, I spent enough time in encyclopedias and natural history museums to know that hills are not everlasting. They just change a lot more slowly than people, so we don't usually see the changes. But we do see the evidence that the changes happen, and are often quite drastic. Nothing is everlasting—not even the planet on which those hills are mere bumps, or the Solar System or Galaxy of which it is a part.

Understanding that, I was even less able to take seriously claims that anything human-made was "everlasting." When I learned how much of the world's wilderness had been sacrificed to make room for civilization, and how deeply satisfying time spent in the few remnants could be, I wanted to believe the reassurances I constantly heard from teachers and politicians. National parks and places like the Adirondack Forest Preserve in New York State, I was told, guaranteed that these scattered reminders of the past would stay "forever wild." I would have loved to believe that—but deep down, I knew that "forever" in this case meant even less. "Forever" is something that many humans seem compelled to seek; but when you think you have it in hand, it is, at best, a comforting illusion.

The "everlasting hills," at least, usually last many human lifetimes. But "forever wild," I've known all along, means "until the politicians in power change their minds." That might be a lifetime or more—or it might be tomorrow.

Or, as it now appears, today.

Washington is currently infested with politicians who think a good way to move the budget closer to balance (and win points with their most useful constituents) is to reduce or eliminate funding for things like national parks, or even to close them down or sell them off to private interests for more "profitable" use. We have people in positions of power over national parks who can say of them, apparently with straight faces, things like, "If you've been there once, you don't need to go again."

Well, maybe he doesn't, but I do. So do a lot of other people. And it just may be that he needs it at least as much as any of us, whether he's capa-

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ble of understanding that or not.

It's true that parks and wilderness preserves are not great producers of income measured in dollars and cents. That's not their job—but their job is at least as important as the generation of Wealth. Their main values are therapeutic and educational. I can testify from many, many personal experiences that periodic immersion in wilderness can be one of the best treatments to restore peace of mind sorely tried by the more exasperating aspects of civilization. And it can serve as a sobering and salubrious reminder that this planet does not exist solely for our convenience, and that everything on it—including us—owes its life to a complicated set of interactions with other living things.

To someone who has spent enough time in wilderness to develop some understanding of it, or even one who has grown up on a farm, that may seem too obvious to mention. But it isn't. For a city kid who has never been to the country before, the awareness of being part of something much larger may be not a reminder, but an astonishing revelation of something previously unsuspected.

Valuable as it is for many things, technology makes it all too easy to forget our relationships to other things. Plenty of city dwellers have little or no grasp of the fact that meat *really* comes from animals and vegetables from "dirt." At least at the gut level, they may associate food with nothing more distant from themselves than a plastic package on a store shelf. Anyone with no more understanding than that is living a life based on a dangerous delusion. If such a person votes or holds office, his or her delusion endangers *all* of us.

You may find it hard to believe that such an extreme form of ignorance exists, but I assure you it does. Subtler variations of it are far more widespread than you might think. I've known people who were brilliant practitioners of one area of science and technology, yet had little or no grasp of ecology—a dangerous situation for people engaged in activities likely to have far-reaching ecological consequences. It may not be their fault; they may simply not have had enough exposure to the ecosystem beyond their own walls to make them think much about it.

Science fiction people place a high value on "sense of wonder," and sometimes bemoan the lack of it in recent examples of their favorite litera-

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ture. But these same people sometimes get so wrapped up in *technology*—the joy of doing nifty tricks with fancy gadgets—that they lose sight of the sense of wonder in *science*. Technology is an outgrowth of science that enables humans to do things that they couldn't do without it, some of which are indeed quite wondrous. Science is the study of *all* the possibilities in the Universe, of which technology is only one subset.

It's possible to get so enthralled by the wonders of technology that you lose sight of the wonders that don't depend on it. Our planet, for example, is an enormously complex and astonishing thing, and it was so even before people started making big changes in it. A large part of the fun of science fiction is imagining how many kinds of *other* worlds might exist, as big and multifaceted as this one—or even more so. Most of us now live in such small, artificial microcosms that we've forgotten—or never learned—just how big, diverse, and remarkable our own world was even before we got our hands on it. The Kyyra, in my novels *The Sins of the Fathers* and *Lifeboat Earth,* had turned whole planets into such artificial microcosms, and were quite overwhelmed by the spectacle of a relatively unaltered planet.

For those who *do* appreciate the magnitude of what natural forces alone have accomplished in creating a world like Earth, the realization may or may not take a religious form. I remember somebody asking the manager of a remote wilderness camp in Africa whether the isolation ever got to him. "Do you miss being able to go to the store," they asked, "or to church?"

"I'm *in* church," he said, gesturing inclusively at the Serengeti all around us, with its distant horizons and in-

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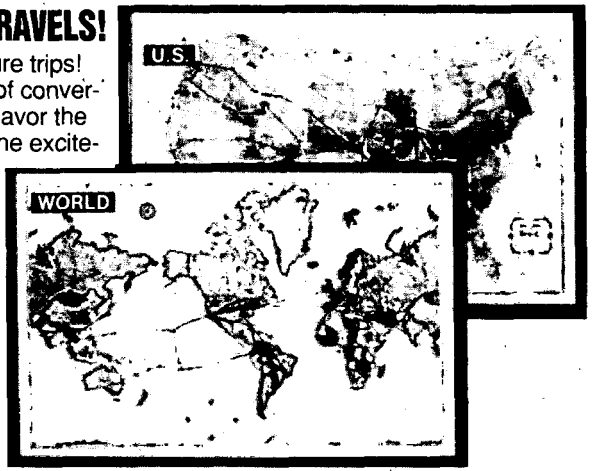

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credible abundance and diversity of life.

And then there was my good friend who looked out from a high ledge in the Rocky Mountains and remarked, "I don't know if there's a God or not—but if there is, He's a hell of a guy!"

Whether or not you see it in theological terms is, it seems to me, a matter of taste, and ultimately not very important. What *is* important, and profoundly so, is that we all need to have some understanding of the fact that there's a lot more to the world than us, and all the pieces are related in a rich tapestry of ways.

Parks and wilderness preserves provide opportunities to see that tapestry close-up. Some might object that not everybody can use them directly, but that hardly justifies doing away with them. First, even those who can't get there can get *some* benefit just by knowing that they're there, by reading or watching television shows about them—though that is, at best, a pale substitute for the real thing. Second, if actual visits to the park have potential value to many people, and not all of them are able to take advantage of it, that doesn't mean we should take them away from those who are already using them. It means we should try to find ways to get those benefits to more people. And since the experience, by its very nature, is ruined by crowding, that means we need *more* parks and wild lands, not fewer.

All these arguments, of course, are based on the value of wild lands to *us*. You might object that that's yet another example of the arrogant anthropocentrism that has already gotten us into some trouble and holds the potential for much more. Privately, I would agree, at least partially—but sometimes you have to work with the materials you can get.

The naturalist Joseph Wood Krutch once observed, "Albert Schweitzer remarks somewhere that we owe kindness even to an insect when we can afford to show it, just because we ought to do something to make up for all the cruelties, necessary as well as unnecessary, which we have inflicted upon almost the whole of animate creation. Probably not one man in ten is capable of understanding such moral and aesthetic considerations, much less of permitting his conduct to be guided by them. But perhaps twice as many, though still far from a majority, are beginning to realize that the reckless laying waste of the earth has practical consequences. . . ."

I tend to agree. Certainly the "everything for a buck" crowd in Washington has flunked the "Krutch test." I don't think it likely that anybody will change their thinking enough to pass it, but it just *might* be possible to convince some of them that "what's in it for us" can include a few things not measurable in dollars and cents—though even that will be an uphill battle.

The value of parks and wild lands is *not* primarily financial. There are those, some of them in positions of high power, of such short and narrow vision that they sincerely believe that the value of all things can be measured by the current quarter's bottom

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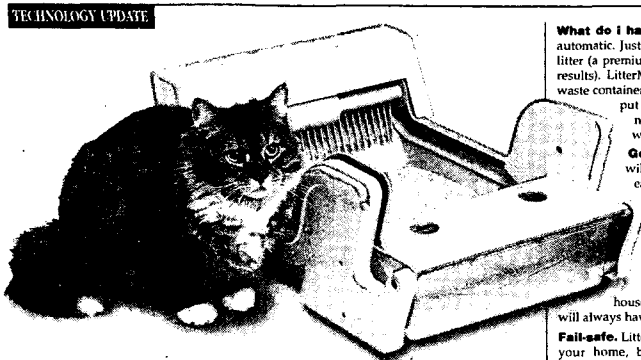

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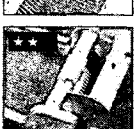

House cats. Large or small, affectionate or independent, young or old, long-haired or short, they all create the same dilemma for their owners—the litter box.

There are few things I can think of that are as foul as cleaning the litter box at my house. Even when I clean it daily, it's difficult to keep odor away. And this problem is multiplied because I have two cats! But because I love them, and that's virtually all the maintenance they require, I do it...because there's no other option.

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line. They, perhaps, need the parks' real benefits most of all, though many of them may be beyond hope of realizing it. The idea that parks and wildlands are always more valuable as sources of salable timber and minerals misses the whole point. But if their fate is in the hands of people who can't grasp that point, we'll have to justify their preservation in terms those people *can* understand.

Space enthusiasts sometimes point out that moving much industry, including mining, into space can and should reduce the pressure on open land and make it possible to preserve more of it. This may be, eventually, but unfortunately we're not very close to having that situation *now*. While we're waiting, and some are fighting another uphill battle to achieve *that* state of affairs, the pressure to mine and log and build on every possible acre goes on. Space may *eventually* reduce the need for Earth-based mining, and more sensible attitudes toward population and economics may eventually reduce the tendency to build more and more housing and shopping centers. But a torn-up wilderness cannot be quickly fixed. "Wrecked" isn't forever, either, but it's close enough on a human scale. Drained wetlands and clear-cut forests can take decades or centuries to fully recover.

Fortunately, elective office isn't forever, either. . . .

If they're doing what they do best, national parks and protected wilderness *won't* turn a profit—unless, perhaps, you charge enormous admission fees. But that turns them into another exclusive toy for the rich; and while many of the rich desperately need to learn the things they can learn from wild lands, they are by no means the *only* ones who need it.

All of us need to be reminded periodically of where we came from and how we fit into a larger scheme—including, most emphatically, those who make laws and public policy. ■

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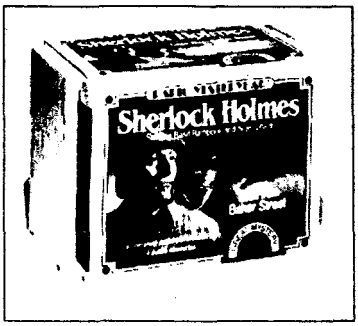

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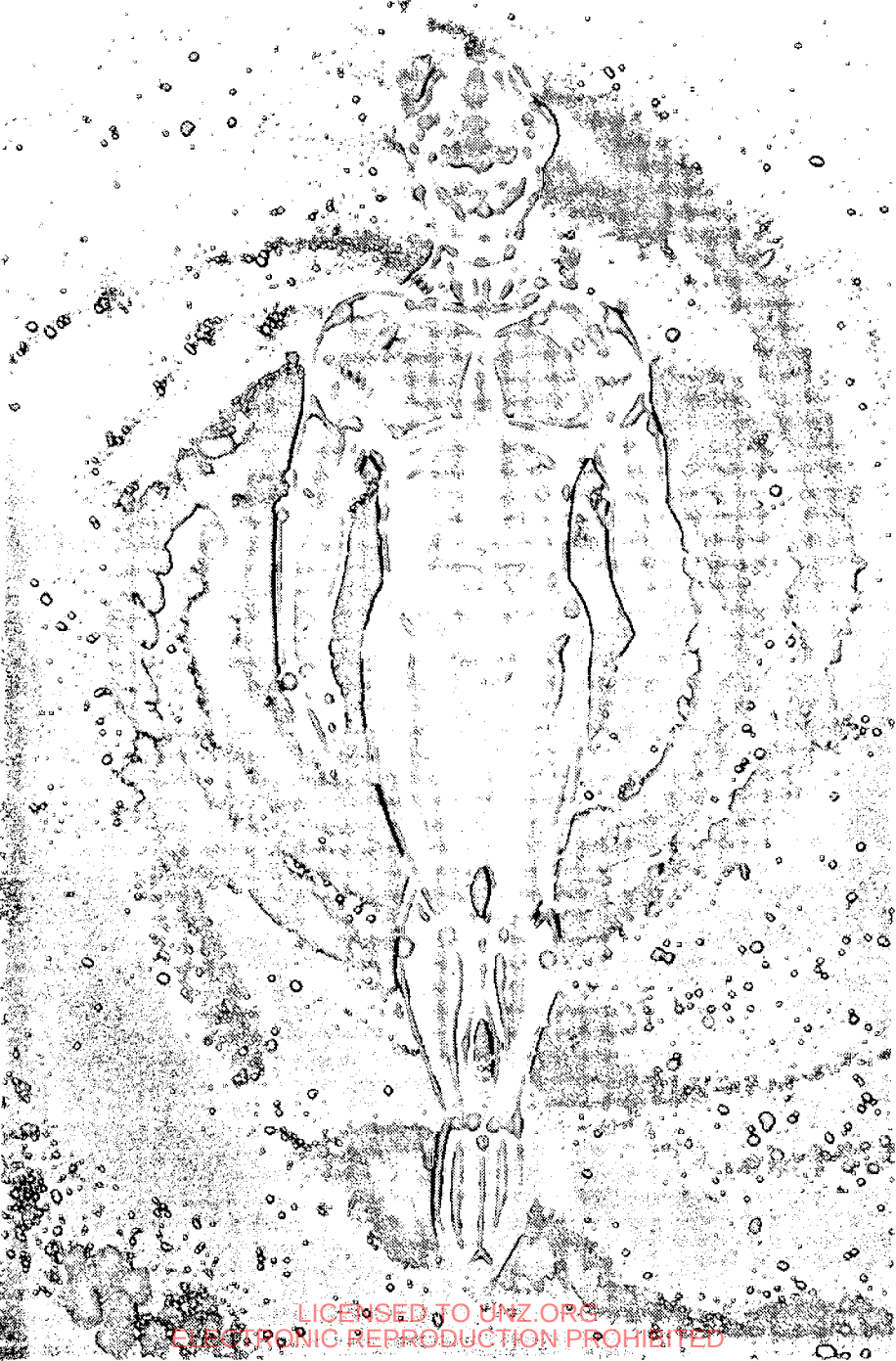

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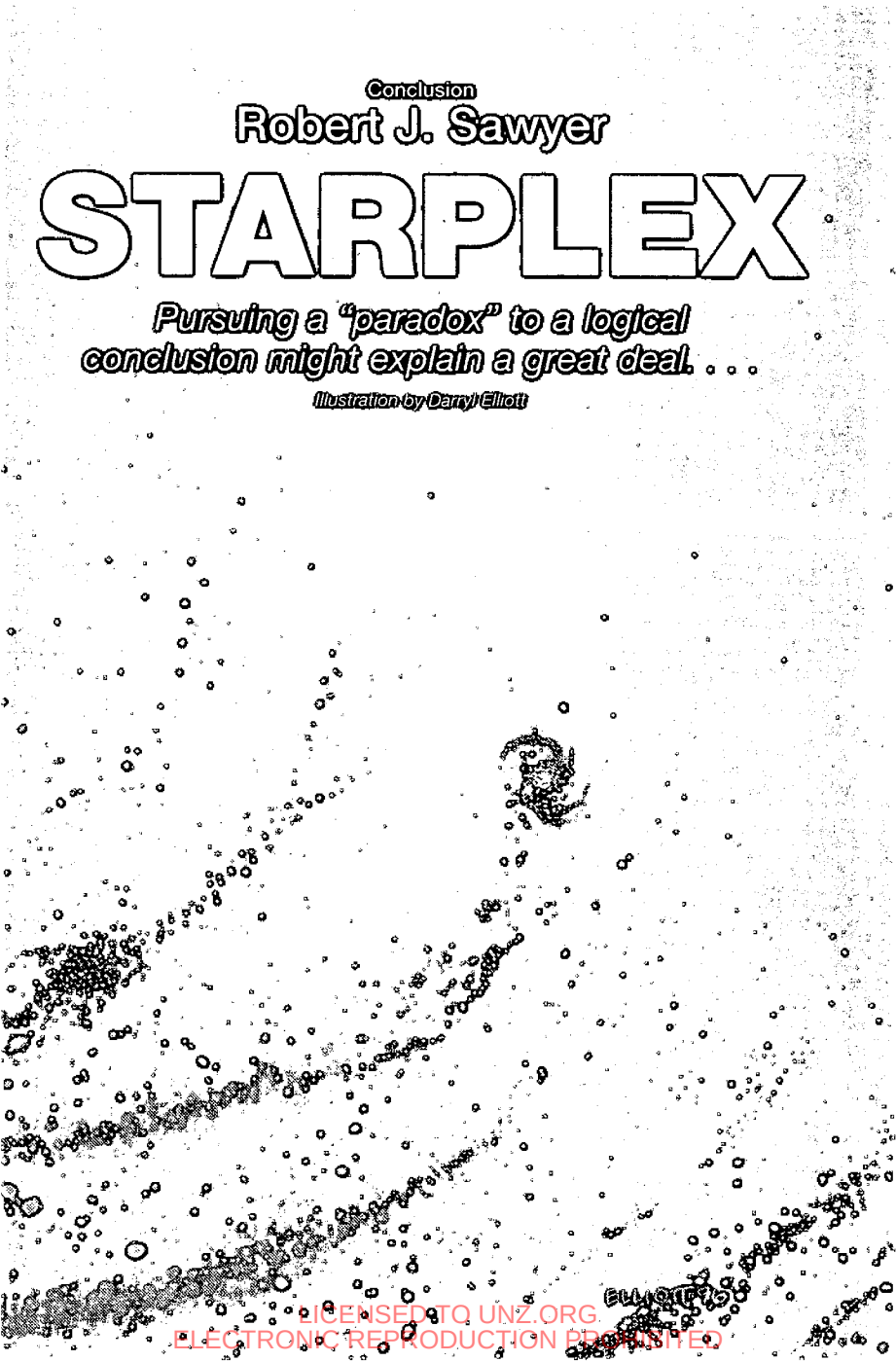
Conclusion

Robert J. Sawyer

STARPLEX

Pursuing a "paradox" to a logical conclusion might explain a great deal. . . .

Illustration by Darryl Elliott



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Synopsis

The giant starship Starplex *is severely damaged, and hundreds of Commonwealth citizens are dead.* **Keith Lansing,** Starplex*'s director, is in a small travel pod, heading away from* Starplex. *He approaches a shortcut—one of four billion artificial and apparently abandoned stargates that permeate the Milky Way Galaxy—selecting the appropriate entrance angle to exit at New Beijing (the Earth colony world of Tau Ceti IV).*

But instead of emerging at his intended destination, Keith arrives near a rose-colored nebula. A starship from some vastly advanced culture, shaped roughly like a dragon, approaches Keith's pod and draws it into a cavernous docking bay. Keith had *correctly selected for Tau Ceti, but he's been diverted—by someone who can control the stargates. Keith realizes he's about to meet the never-before-seen makers of the shortcut network.*

The bay's interior is transformed into a simulation of Earth's countryside. A transparent humanoid figure, whom Keith dubs **Glass,** *appears. He says Keith holds the key not just to the future, but also the past. The humanoid is inordinately interested in Keith's family: his wife,* **Clarissa "Rissa" Cervantes,** *who serves as* Starplex*'s head of life sciences, and their son Saul, now off at university. But soon Glass is called away, and Keith is left to explore the Earth simulation. He notes that some of the details are wrong: all the clover is four-leafed, and although he recognizes many of the plant and animal species, he also sees an emerald songbird that's completely unfamiliar.*

Glass returns and Keith demands that he explain who he is and why he's so interested in Keith. The answer is amazing: the glass man is *Keith—Keith from ten billion years in the future. The rose-colored nebula is what's left of Sol, after it had been forced into a nova explosion in order to recycle its heavy atoms into the interstellar medium. Keith is left staggered by this, while we learn the story of how he got to this point. . . .*

The year is 2094. Eighteen years earlier, the shortcut network was discovered. Shortly thereafter, humans and dolphins joined with two alien races to form the Commonwealth of Planets. The alien races are the Ibs (wheeled, gestalt creatures from the planet Flatland, 53,000 light-years from Earth) and the Waldahudin (six-limbed, piglike creatures from the planet Rebbollo, 70,000 light-years from Earth).

A shortcut is inactive until something enters it locally. When a new shortcut comes on-line, the giant Commonwealth research vessel Starplex *is dispatched to investigate. But when* Starplex *emerges at the most recently activated exit point, the crew is amazed to see* twinkling *stars in open space.*

Of course, it turns out that the stars aren't really twinkling. Rather, they're being obscured by clouds of dust and hundreds of giant Jupiter-sized spheres. The spheres seem

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packed much closer together than their gravity would normally allow.

Automated probes are sent into one of the spheres, and samples are brought on-board. The material is bizarre indeed: it has no electrical charge whatsoever, it can pass through regular matter, and, in addition to its long-range gravitational force, it also possesses a short-range repulsive force. **Jag,** *the Waldahud who serves as* Starplex*'s head of physical sciences, is the first to realize that the material is* dark matter. *Dark matter makes up the vast bulk of the mass of the Universe; its gravitational effects are detectable, but its actual nature has never been determined.*

Other research is going on simultaneously aboard Starplex. *Rissa and an Ib named* **Boxcar** *are undertaking experiments in life prolongation, although so far they've had no luck. Rissa confides to Boxcar that she's concerned that her husband Keith is contemplating an affair with another woman, possibly* **Lianne Karendaughter,** Starplex*'s internal-operations manager. Meanwhile, Keith finds himself fighting with Jag. Jag is one of five males competing for a specific female; he is determined to find glory enough to win her, no matter what.*

Suddenly the shortcut nearest Starplex *starts to open up. What appears to be a starship fusion exhaust is blasting through the aperture, as if a vessel had been braking when it entered the stargate. But the aperture keeps growing larger and larger, and the fusion exhaust is green. A tongue of plasma shoots out toward* Starplex. *As the shortcut continues to swell in size, Jag realizes that the object emerging from it isn't a spaceship—it's a star!*

Starplex *is bombarded with radiation from the star. Keith turns the ship so that its lower decks face the shortcut, and everyone is evacuated to above the central ocean deck; the water in it provides shielding from the radiation until the ship reaches a safe distance.*

Jag and a dolphin named **Longbottle** *do a flyby of the star in a heavily shielded probeship. Jag is perplexed by what he finds: a star with so much metal content simply should not exist in a Universe as young as ours.*

A communications buoy pops out of the shortcut with staggering news: stars have also emerged from the shortcuts nearest Tau Ceti and Rehbollo—and the phenomenon may be even more widespread than that.

At first, the Starplex *crew thinks the erupting stars might represent an attack on the Commonwealth worlds. But soon another star—also green—is detected having recently come out of an* inactive *shortcut nowhere near any habitation. Incredibly, it seems as though stars may be emerging through all four billion shortcuts throughout the Milky Way.*

Jag was willing to consider one green metal-rich star a freak, but the best explanation he can come up with for multiple ones is that they are fourth-generation *stars arriving from billions of years in the future.*

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The shortcuts don't just allow travel in space; they also serve as portals back into time.

But why would stars be sent into the past? A logical question—and the logical person to ask for the answer is someone in the far future. Jag constructs a cube that will last for many billions of years, with a symbolic question etched into its surface: "Shortcut with star emerging from it equals what?" The cube, which has starlight-powered positioning jets, is released from Starplex *near the shortcut, in hopes that beings from the future will stumble across it and send an answer back to the past.*

Meanwhile, tempers continue to flare aboard Starplex. *The humans and Waldahudin seem incapable of getting along.* Starplex *takes a quick trip to Flatland to replace its irradiated lower habitat modules. And Rissa is stunned when Boxcar announces that she's going to kill herself soon, as punishment for a minor crime committed in her youth.*

It's discovered that the dark-matter spheres are giving off weak radio signals—and the signals are complex enough to possibly represent a language. As the crew watches, amazed, one of the dark-matter spheres splits into two. The spheres are giant living creatures, which the crew decides to call "darmats." Attempts are made to communicate with them via radio, establishing a dialog with the darmat leader, **Cat's Eye.**

The shortcut nearest Starplex *opens again—and the cube Jag built pops out. A message carved into it says, "Pushing back the stars is necessary, and not a threat. It will benefit us all. Don't be afraid." Incredibly, the message is signed "Keith Lansing," and is apparently dated the year 10,646,397,281 A.D. Rissa realizes that her life-prolongation experiments are going to succeed beyond her wildest dreams.*

Conversations continue with the darmats. Cat's Eye contends that the Commonwealth races are insignificant because they're only recent arrivals in the Universe. By contrast, says Cat's Eye, intelligent darmats have existed since almost the beginning of time. Although Starplex *is communicating with the darmats by normal radio, Cat's Eye reveals that they also have a natural faster-than-light communications ability.*

Boxcar separates into her component parts, committing suicide. Keith and Rissa plan to renew their wedding vows on their twentieth anniversary, but Keith, realizing now that he's apparently going to live for billions of years, is having second thoughts about repeating "for as long as we both shall live."

Jag requests that Starplex *be moved to the far side of the group of darmats, putting the shortcut out of view. Shortly thereafter,* Starplex *is attacked by an armada of Waldahud ships. The leader of the armada,* **Gawst,** *intends to seize* Starplex. *Humans and dolphins, including Rissa and Longbottle, board probeships armed with makeshift weapons, and take off to defend* Starplex. Starplex *sustains heavy damage, and water from its central ocean deck starts*

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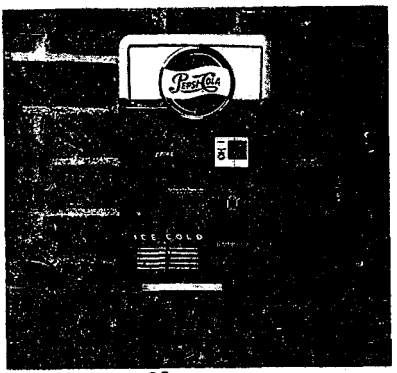

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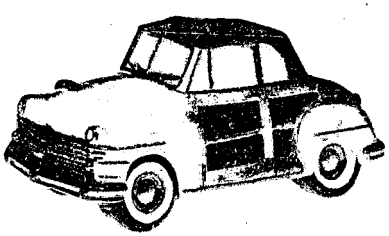

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flooding into the lower habitat modules. Keith orders everyone evacuated from those decks.

The artificial gravity is shut off, and the ship is spun rapidly on its axis. Keith has a hole drilled from one of the docking bays into the ocean deck. Water sprays out into space, evaporates immediately, recondenses into liquid, then freezes into pellets of ice, which fling away from the spinning ship. By adjusting Starplex*'s angle, the stream of ice bullets is aimed at some of the attacking ships, ripping them apart.*

The darmats get into the fray, too: using their gravitational influence, they start tossing Waldahudin ships into the green star. The Starplex *crew thinks the darmats have come to their rescue, until the darmats start converging on* Starplex *itself. To escape, Keith orders* Starplex *to slingshot around the green star and into the shortcut. At such speeds, though, there's no way to calculate which other shortcut they will emerge from. Most of the probeships return to* Starplex, *but Rissa and Longbottle, aboard the probeship* Rum Runner, *are too far away to make it back; Keith locks a tractor beam onto them, and sends* Starplex *diving around the green star.*

Just before they hit the shortcut, Starplex *experiences a power failure due to battle damage. The tractor beam shuts off, and the* Rum Runner *is lost.* Starplex *hurtles through at extremely high speed . . . and emerges in the empty void of intergalactic space.*

Rissa and Longbottle manage to make it through the shortcut, too, but they emerge at Tau Ceti, directly behind a Waldahud mothership, which is attempting to seize control of the United Nations space station adjacent to the shortcut. At the moment the Rum Runner *arrives, the mothership has all of its shields diverted forward. Rissa fires her geological laser, destroying the mothership and saving Tau Ceti.*

Jag makes the staggering finding that Starplex *is now six billion light-years from home. Even more staggering: the view of the Milky Way from here, showing it as it appeared six billion years ago, reveals a simple disk-shaped Galaxy without spiral arms. Jag is baffled: although there's never been a good explanation for the origin and persistence of spiral arms, it had always been thought that the Milky Way had arms even that long ago. Without them, life never would have arisen—it's only in the arms, far away from the highly radioactive galactic core, that stable organic molecules can exist.*

Keith and Jag both stare at the young Milky Way, cupping its image in their hands, contemplating the futures of their feuding races. Repairs are completed, and Keith orders a probe sent through the shortcut network to see if it's safe to bring Starplex *back to the vicinity of the dark-matter beings. . . .*

Part 4

CHAPTER 20

"Launching probe," said Rhombus.

In the holo bubble, Keith could see the silver and green cylinder moving

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away from the ship, illuminated by a tracking searchlight on *Starplex*'s hull. It looked out of place against the fuzzy splotches of distant galaxies. Soon the probe touched the shortcut and disappeared.

"The run should only take about five minutes," said Rhombus.

Keith nodded, trying to contain himself. He didn't know which he wanted more: to have the probe report that it had detected Rissa's transponder—meaning the *Rum Runner* was at least still intact—or for it to report nothing, meaning the probeship might have made it through the shortcut to safety.

Time passed, and Keith's nervousness grew. A watched pot never boils, but. . . .

He looked up at the trio of clocks floating in space above the hidden port-side door. "How long has it been?"

"Seven minutes," said Rhombus.

"Shouldn't your probe be back by now?"

Lights moved up the Ib's web.

"Then where the hell—?"

"Tachyon pulse!" announced Rhombus. "Here it comes."

"Don't wait until it's docked," said Keith. "Download the data by radio and display it."

"Doing so with delight," said Rhombus. "Here we go."

The probe's scan was low-resolution, and video, rather than holographic. A part of the all-encompassing bubble was framed off in blue, and playback of the flatscreen images the probe had recorded began to appear.

"What the—?" said Keith. "Rhombus, did you use the correct angle of approach?"

"Yes—to within a fraction of a degree."

Jag said a Waldahudar swear word. By default, PHANTOM didn't translate profanity, but Keith felt like swearing himself. "That's not where we came from," he said.

Jag's fur was motionless. "No," he said. The image in the screen showed tightly packed red stars. "At a guess, I'd say it's not even anywhere in the Milky Way. That looks like the inside of a globular cluster. There are dozens associated with CGC 1008, so it might even be one of those."

"Which means—"

"Which means," said Thor, lifting his hands from the helm console, "that we can't go home. We don't have the correct address."

"The latitude/longitude coordinate system must not work the same way over such great distances," said Lianne.

Keith's voice was small. "Even at full hyperdrive—"

Jag snorted. "Even at full hyperdrive, to cover six billion light-years would take two hundred and seventy million years."

"All right," said Keith. "We'll try sending probes through in a search pattern. Rhombus, start by piercing the tachyon sphere around the shortcut at the north pole, then work your way down trying again at every five degrees of latitude and five degrees of longitude. Maybe, if we're really lucky, we'll see something we recognize in the scans they bring back."

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Rhombus began launching probes, but it soon became apparent that they were all going to either the globular cluster, or to another region of space where the sky was dominated by a ring-shaped nebula.

"From the point of view of this shortcut," said Rhombus, "there are only two other active shortcuts. I suppose that means we're lucky our initial probe came back to us—it only had a one-in-two chance of doing so."

"Not much of a choice, is it?" said Keith. "Here on the periphery of a black hole in intergalactic space; off in a globular cluster—presumably full of old, lifeless stars; or over to that ring nebula."

"No," said Jag.

"No what?"

"No, we cannot be limited to those choices."

Keith let out a sigh of relief. "Good. Why not?"

"Because the God of Alluvial Deposits is my patron," said the Waldahud. "She would not abandon me."

Keith felt his heart sink. He stopped himself before he snapped out something nasty.

"There *has* to be a way back," said Jag. "We came here, and therefore we must be able to return. If only we—"

"Speed!" shouted Lianne.

Keith looked at her.

"Speed!" she said. "We went through the shortcut at very high speed. Perhaps the velocity range at which you enter a shortcut selects which other family of shortcuts you have access to. We've always previously done it at very low relative velocities in order to avoid impacts. After all, one does go through a shortcut blind, not knowing for sure what's on the other side. But this time, we whipped into it at substantial fraction of light-speed. We may have keyed into another level of shortcuts by doing so."

Keith turned to Jag. He lifted all four shoulders. "It's as good an explanation as any."

"Rhombus, launch another probe," said Keith. "Put it on a long trajectory that will let it accelerate to the same speed we were at when we passed through the shortcut, and aim for the exact latitude and longitude that corresponds to where we came from."

"Doing so with transcendent joy," said the Ib.

The probe was launched, built up speed, pierced the shortcut. They all held their breaths. Even Rhombus's pump, which operated without guidance from the pod, apparently sensed that something important was happening. Its central orifice temporarily halted its constant sequence of open, stretch, compress, and close.

And then the probe returned. Rhombus's ropes whipped his console, making loud slapping sounds as they did so, and the framed-off area filled with the probe's recorded images.

Thor was grinning from ear to ear. "I never thought I'd be glad to see that thing again," he said, jerking a thumb at the image of the green star.

Keith breathed a long sigh of relief. "Thank—thank the God of Alluvial Deposits."

"According to the probe's hyperscope, the darmats have moved well

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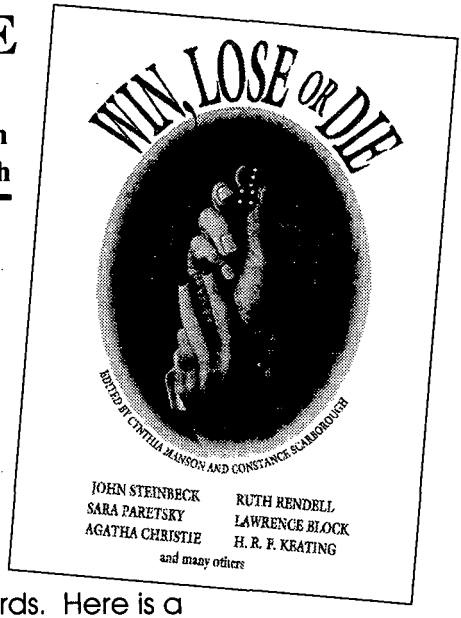
The Odds Are for Murder

WIN, LOSE OR DIE

Edited by Cynthia Manson and Constance Scarborough



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away from the exit point," said Rhombus.

"Excellent. Thor, take us home. Execute the course we discussed earlier. I want to have a word with Cat's Eye."

CHAPTER 21

Starplex moved through the intergalactic abyss toward the shortcut. The ship—seeming minuscule amidst all the emptiness—gathered speed as it approached, Thor revving up the thrusters. When it touched the shortcut, a ring of violet fire passed over the vessel as it traversed six billion light-years—60,000,000,000,000,000,000,000 kilometers—in the blink of an eye. There was a spontaneous cheer from those on the bridge as the holographic bubble was filled again with countless stars. Keith felt his eyes stinging, the way they had the last time he'd returned to Earth.

Thor immediately began making manual adjustments; they hadn't been monitoring the green star long enough to know its exact trajectory away from the shortcut, and his guess of where it would be was somewhat off. He soon had the ship settled into the parabolic course Keith wanted—a much wider parabola than their previous passing, avoiding any dangerous proximity to the green star, which now once again dominated the holo bubble.

"Scan for the *Rum Runner*'s transponder," said Keith.

"Doing so," said Lianne. But then, a moment later, "I'm sorry, Keith. There's nothing."

Keith closed his eyes. She could be safe, he told himself, she could have gone through to another exit, she could—

"Tachyon pulse!" said Rhombus in what PHANTOM translated as a shout.

Keith swiveled around to look at the shortcut, now swelling into a purple-limned shape—in the exact cross-sectional outline of a Commonwealth probeship.

"It's the *Rum Runner*!" crowed Thor.

"Incoming signal," said Lianne. She touched keys and a hologram of Rissa's beaming face appeared inside a floating frame.

"Hello, everyone," said Rissa. "Fancy meeting you here."

"Rissa!" said Keith, rising to his feet.

"Hello, darling," said Rissa, smiling radiantly.

"Rhombus," said Keith, "can they dock with us, given the course we're on?"

"They can if I give them a tow with a tractor beam."

Keith was grinning widely. "Please do so!"

"OK, guys," said Rhombus, "prepare to be grabbed by a tractor."

Longbottle's gray face popped up next to Rissa's. "Prepared are we! Home we come!"

"Locking on," said Thor.

"Thor," said Keith, "do you have a fix on Cat's Eye?"

"Yes. He's about ten million klicks ahead, at about nine o'clock to the green star."

"I've located a vacant frequency in the darmat babble, in case you want to talk to him," said Lianne. "Somebody must have left the conversation recently."

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"Excellent," said Keith. "Keep track of it. As soon as Rissa's back on board, I'll want to open communication."

"We'll have the *Rum Runner* in docking bay seven in about three minutes," said Rhombus.

Keith was anxious as hell. He tried to hide it by checking status reports on his monitor screens, but his mind wasn't registering the words. At last, the starfield split and Rissa appeared, framed by the corridor beyond. Keith ran to her, and they hugged, then kissed. The rest of the bridge crew cheered as she entered. A moment later, Longbottle popped up in one of the two open pools. Rissa knelt down beside him and rubbed his bulging forehead. "Thanks for getting us home safe and sound, buddy," she said.

"We're doing a quick parabolic path," Keith said to them. "I don't think the darmats can grab us this time, but I want to communicate with them—find out why in the hell they attacked us."

Rissa nodded, stood up, kissed Keith once more, then moved over to her workstation. She pressed keys, calling up the translation program.

"Do we still have a vacant frequency?" asked Keith.

"Yes," said Lianne.

"All right. Let's jump into the conversation. Lianne, open a channel from my console with automatic translation, but put a five-second delay in before you send whatever I say." He looked at Rissa. "I'll speak directly to Cat's Eye, but if I say anything wrong or something that you don't think will translate properly, jump in, and we'll reword the message before it goes out."

Rissa nodded.

"Ready," said Lianne.

"*Starplex* to Cat's Eye," said Keith. "*Starplex* to Cat's Eye. We are friends. We are friends." Keith glanced at a counter. At light-speed, it would still be thirty-five seconds before the message reached Cat's Eye, and almost that long again before any reply would arrive.

But no reply came. Keith waited an extra full minute, then another. He touched a key and tried again. "We are friends."

Finally, after a forty-second delay in addition to the round-trip signal time, a reply came through. Just two words, in a curt French accent: "Not friends."

"Yes," said Keith. "We are friends."

"Friends not hurt," came the reply, with no delay beyond that caused by transmission times.

Keith was taken aback. Had they somehow hurt the darmats? It was almost inconceivable that they could injure such giant creatures. Still . . . perhaps the sampling probes had caused pain. Keith didn't have the slightest idea how to apologize; the vocabulary Rissa had built up didn't deal with such concepts.

"We did not mean to hurt you," said Keith.

"Not directly," said Cat's Eye.

Keith spread his hands and looked around the bridge. "Anybody understand that?"

"I think he means whatever injury we caused wasn't a direct injury," said Lianne. "We didn't hurt them, but hurt—or were going to hurt—some-

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thing that was important to them."

Keith touched the transmit key. "We intend no injury to anything. But you—you deliberately tried to kill us."

"Make you. Not make you."

Keith keyed the mike off. "'Make you. Not make you,'" he repeated, shrugging helplessly. "Anybody?"

Lianne lifted her hands, palms up. Jag moved all four of his shoulders. Rhombus's web was dark.

Keith reactivated the mike. "We want to be friends again."

The response time was getting shorter as *Starplex*'s parabolic course brought the ship closer to Cat's Eye. "We want to be friends again, too," said the darmat.

Keith thought for a moment, then: "You say we injured you somehow. We did not intend any injury. So that we don't do it again, will you tell us what we did wrong?"

The delay time was nerve-wracking. Finally: "Attacking each other."

"You were bothered by the battle?" asked Keith.

"Yes."

"Worried that explosions would hurt you?"

"No."

"But then why did you fling those ships into the star?"

"Afraid."

"Of what?"

"That your activities would destroy . . . destroy . . . point that is not a point."

"The shortcut? You were afraid that we would destroy the shortcut?"

"Yes."

"No explosion could damage the shortcut. It's not fragile."

"Did not know."

Jag barked softly. "Ask him why he cares."

Keith nodded. "Why do you care about the shortcut, anyway? Do you use it yourselves?"

"Use? No. Not use."

"Then why?"

"Spawn."

"They're important to your spawning practices?"

"No, one of our spawn," said the voice from the speaker.

It was frustrating—and probably as much so for the darmat as it was for Keith. Cat's Eye was used to being part of a community whose members had been talking amongst themselves for millennia. They understood the context of each other's remarks, the history. Explicating a thought in detail was not normal for them—and possibly even rude. "One of your spawn," Keith said again, helpfully.

"Yes. Touched the point that is not a point."

Oh, my God. "You mean one of your youngsters went through the shortcut?"

"Yes. Lost."

"Christ," said Thor, turning around. "That's what activated this shortcut—a darmat baby going through!"

Keith leaned back in his chair. "And if our fighting had accidentally destroyed the shortcut, your child would never have been able to find its way home again, right?"

"Rightness abounds. When you first arrived, we thought you had come to bring our spawn home."

"You never asked us about that."

"Wrong to ask."

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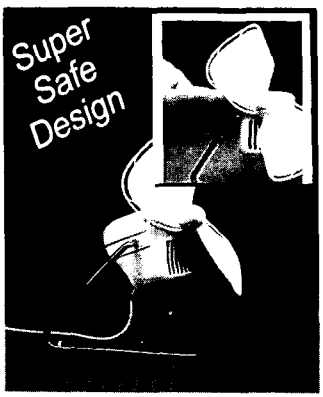

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"Darmat bad manners," said Rissa, eyebrows raised.

Keith spread his arms. "We didn't know about your child. How long ago did it go through the shortcut?"

"Time since you first arrived, doubled."

Keith turned to his left, looking at Jag. "The child couldn't have gone far from the exit point, then. Any way of knowing which shortcut it would have come out from?"

"Well," said Jag, "the child must have emerged through an already active exit. But, as we found when we went careening through this shortcut ourselves, there are more active exits than we were aware of—possibly trillions more, if they permeate intergalactic space and other galaxies. And, since the shortcuts rotate, without knowing to the second what time the child went through, even duplicating the approach angle wouldn't help us. The thing could be anywhere."

"But if we could find the child and bring it safely home," said Keith, "well, not only would that be the right thing to do, it would also help cement our relationships with the darmats." He looked around the bridge. "Anyone disagree?" He turned the mike back on. "Does the child have a name? A unique identifying word?"

"Yes. It is"—PHANTOM's own voice replaced the synthesized one coming through the speaker—"untranslated term."

Keith gestured at PHANTOM's eyes. "Call it—call it Junior," he said.

"Acknowledged."

Keith looked over at Rhombus, who could see Keith clearly, of course, even though his backside was to him. "Rhombus, what do you think?"

"It could be a very steep slope that ends in a cliff," he said—a wild-goose chase. "But, as you have said, establishing friendly relationships is what *Starplex* is all about. I say we at least try."

"Should we ask one of them to come with us?" asked Lianne.

"There is no way we could go through the shortcut together," said Thor, turning to face her. "Remember, even the smallest of those beings masses as much as Jupiter. And without precisely controlling its entrance angle, the darmat might end up coming out of a different shortcut, meaning we'd have two lost darmats, instead of one."

Keith reactivated the mike. "We will look for your child," he said. "Would you please call out to it? We will record that, and play it back at each possible place it might be. Call out to it, and ask it to come with us. Tell it that we will not hurt it, and that we only want to guide it home."

"Record?"

"Like an oral history; we will repeat it."

"Doing," said the voice from the speaker. Keith let the entreaties spill into PHANTOM's memory.

"We have it," said Keith, once Cat's Eye stopped transmitting.

"Find our child," said Cat's Eye. "I—words unavailable."

The translation exercises hadn't covered this topic. But Keith understood across species lines—across

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matter lines. He nodded.

CHAPTER 22

Keith was in his office, going over proposals for finding the darmat baby. It was the first of the month; the holo on his desk of Rissa had automatically changed to a pose of her in shorts and tank top, taken during a hike through the Grand Canyon. The Emily Carr painting had switched to an A. Y. Jackson view of Lake Superior.

"Jag Kandaro em-Pelsh is here," announced PHANTOM.

Keith spoke without looking up from the datapad he was reading. "Let him in."

Jag entered and helped himself to a chair. He had all four arms crossed in front of his massive chest. "I want to go get the darmat child," he barked.

Keith leaned back in his chair and looked at the Waldahud. "You?"

Jag's dental plates clicked together defiantly. "I."

Keith breathed out slowly, using the time it took to complete the exhalation to gather his thoughts. "This is a delicate mission."

"And you do not trust me anymore," said Jag. He moved his upper shoulders. "I realize that. But the attack on *Starplex* was not authorized by Queen Trath. And the attack on Tau Ceti that Rissa has told us about was repulsed. Matters are at an end right now—unless you humans wish to prolong them. Where do we go from here, Lansing? Is it over? Or do we go on fighting? I am prepared to act as if—"

"As if nothing had happened?"

"The alternative is war. I do not want that, and I had believed you did not want it, either."

"But—"

Jag's barks were sharp. "The choice is yours. I have volunteered a peaceful co-existence. If you want your—what is the human metaphor?—your pound of flesh, I refuse to grant it. But finding the child and getting it home will require the utmost skill in short-cut mechanics. Magnor is good at such matters, but I am better. Indeed, there is no one better in all the Commonwealth. You know this to be true; if it were not, I would not be assigned to this ship."

"Thor is trustworthy," said Keith, simply.

The Waldahud's two right eyes were already locked on Lansing, and a moment later the two left ones converged on him as well. "The choice is yours. You have my report." He gestured at the datapad Keith was still holding. "I have suggested we send a probeship to find the child. I should be on that ship."

"All you want," said Keith, "is access to the darmats for your people. Bringing home their child would earn you much gratitude."

Jag moved his lower shoulders. "You do me a disservice, Lansing. Indeed, the darmats do not yet know that there are a thousand entities aboard this ship, let alone that they represent a quarter-sixteen of races."

Keith thought for a moment. Damn, he hated being pushed. But the bloody pi—but Jag was right. "OK," he said. "OK—you and Longbottle, if he's up to it. Is the *Rum Runner* in any condition for another mission?"

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"Dr. Cervantes and Longbottle had it serviced at Grand Central," said the Waldahud. "Rhombus has confirmed that it is spaceworthy."

Keith looked up. "Intercom: Keith to Thor."

A hologram of Thorald Magnor's head appeared floating above Keith's desk. "Yes, boss?"

"How are we for travel through the shortcut?"

"No probs," said Thor. "The green star is far enough from it now to allow just about any entrance angle. You want me to program a run?"

Keith shook his head. "Not for the whole ship. Just a one-person travel pod. I'm going to have to return to Grand Central for a meeting with Premier Kenyatta." Keith looked back at the Waldahud. "Despite what you just said, Jag, there's going to be hell to pay."

It was the ultimate grand tour: around the Galaxy in twenty shortcuts—a quick survey of all the active exit points. The *Rum Runner,* with Jag and Longbottle aboard, zoomed away from *Starplex*'s docks and, after Longbottle's requisite joyride, headed for the shortcut.

As always, the exit point expanded as the ship touched it. The purple discontinuity moved from bow to stern, and then the ship was zooming through a different sector of space. There were no spectacular sights to be seen at this first exit: just stars, somewhat less-densely packed than they had been on the other side.

Jag was intent on his instruments. He was doing a hyperspace scan, looking for any large mass within a light-day of the exit. Finding the darmat child would be hard. Dark matter, by its very nature, was very difficult to detect—all but invisible, and the radio signals it put out were very weak indeed. But even a baby darmat was going to mass 10^{37} kilograms. It would make a dent in local space-time that should be detectable in hyperspace.

"Anything?" asked Longbottle.

Jag moved his lower shoulders.

Longbottle arched in his tank, and the *Rum Runner* curved back toward the shortcut.

"Again we go," said the dolphin. The ship dived toward the point—

—And popped out near a beautiful binary star system, streamers of gas flowing from a bloated, oblate red giant toward a tiny blue companion.

Jag consulted his instruments. Nothing. The *Rum Runner* did a loop-the-loop and came down upon the shortcut from above, diving through, a burst of Soderstrom radiation washing over the ship, the spectacle of the binary pair being replaced by a new starscape, with a great yellow and pink nebula covering half the sky, a pulsar at its heart cycling dim and bright over a period of a few seconds.

"Nothing," said Jag.

Longbottle arched again, and plunged toward the shortcut.

An expanding point.

A ring of purple.

Mismatched starfields.

Another sector of space.

A sector dominated by another green star pulling away from the shortcut. Longbottle maneuvered furi-

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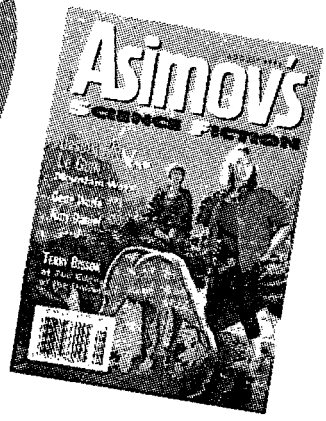

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ously to avoid it.

Jag's scan took longer; the nearby star overwhelmed the hyperspace scanner. But, finally, he determined the darmat child was not there.

Longbottle rotated in his tank, and the *Rum Runner* did a corkscrew flight back into the shortcut. When they popped out this time, it was through Shortcut Prime, near the galactic core, the initial shortcut that had presumably been activated by the shortcut makers themselves. The sky blazed with the light of countless tightly packed red suns. Longbottle nosed a control, and the ship's shields increased to maximum. They were close enough to the heart of the Galaxy to see the coruscating edge of the violet accretion disk surrounding the central black hole.

"Not here," said Jag.

Longbottle maneuvered the ship back to the shortcut in a simple straight line. They hadn't been close enough to be caught by the singularity's ravenous gravity, but he was taking no chances.

They next exited into another seemingly empty region of space, but Jag's hyperspace scanners indicated the presence of substantial concealed mass.

"Suppose not do you?" asked Longbottle.

Jag shrugged all four shoulders. "It couldn't hurt to check," he said, adjusting the shipboard radio to search near the 21-centimeter band.

"Ninety-three separate frequencies currently in use," said Jag. "Another community of darmats."

They were tens of thousands of light-years from the first darmats they had encountered, but, then again, the darmat race was billions of years old. It was possible that they all spoke the same language. Jag scanned the cacophony, found the topmost frequency group, and, since there were no vacancies, transmitted just above it. "We are looking for one called Junior"—the ship's computer substituted the baby's real name.

There was silence for a lot longer than round-trip message time would require, but then, finally, a reply did come through.

"No one here by that name. Who are you?"

"No time to chat—but we'll be back," said Jag, and Longbottle turned the ship back toward the shortcut.

"Bet surprised them that did," said the dolphin as they passed through the gateway.

This time they emerged near a planet about the size of Mars, and just as dry, but yellow rather than red. Its sun, a blue-white star, was visible in the distance, about twice the apparent diameter of Sol as seen from Earth. "Nothing here," said Jag.

Longbottle allowed himself the luxury of moving the *Rum Runner* in such a way that the bulk of the yellow planet precisely eclipsed the star. The corona—mixing purple and navy and white—was gorgeous, and covered much more of the sky than the dolphin had expected. He and Jag basked in the sight for a moment, then they dived back through the shortcut.

This exit point had also recently had a star emerge from it, but it wasn't green. Rather, as at Tau Ceti, this one

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was a red dwarf, small and cool.

Jag consulted his scanners. "Nothing."

They dived through again, the shortcut opening like a purple-lipsticked mouth to accommodate them.

Pure blackness—no stars at all.

"A dust cloud," said Jag, his fur dancing in surprise. "Interesting—it wasn't here the last time anyone went through to this exit. Carbon grains mostly, although there are some complex molecules, too, including formaldehyde and even some amino acids, and—Cervantes will want to return here, I think. I'm picking up DNA."

"In the cloud?" asked Longbottle, incredulous.

"In the cloud," said Jag. "Self-replicating molecules floating free in space."

"But no darmat, correct?"

"Correct," said Jag.

"A wonder for another time," said Longbottle, and he spun the ship around, fired retros, and headed back through the shortcut.

A new sector of space—another one that had recently had a star erupt from it. This time the intruder was a blue type-O, with more purple sunspots than a fair-haired human had freckles in summer. The *Rum Runner* had emerged right on the edge of one of the Milky Way's spiral arms. To one side, the sky was thick with bright young stars: to the other, they were sparse. Overhead, a globular cluster was visible, a million ancient red suns packed together into a ball. And—

"Bingo," said Jag—or, at least, he barked something that would be translated as that in English. "There it is!"

"See do I," agreed Longbottle. "But—"

"Parched land!" swore Jag. "It's trapped."

"Agree—caught in the net."

And indeed it was. The baby darmat had obviously stumbled out of the shortcut only a few days before this blue star had arrived, and the star had been expelled from the exit in approximately the same direction as the darmat. As they'd all discovered to their shock, a darmat could move with surprising agility for a free-floating world, but the gravity of a star was enormous. The baby was only forty million kilometers from its surface—less than Mercury's distance from Sol.

"There is no way it can manage escape velocity," said Jag. "I'm not even sure it's managed to settle into orbit; it may be spiraling in. Either way, though, that darmat is not going anywhere."

"Will signal," said Longbottle—and he set the ship's transmitter to broadcast the pre-recorded message on all the frequencies that the members of the darmat community had used.

They were about three hundred million kilometers from the star; the signals took over fifteen minutes to reach the darmat, and the quickest any reply could be received would be another fifteen minutes after that. They waited, Jag fidgeting, Longbottle amusing himself by painting a sonar caricature of Jag as he fidgeted. But no reply was received.

"Well," said the Waldahud, "there's so much radio noise coming from the star, we might not be able to pick up

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the darmat's transmission. Or it might not be able to hear us."

"Or," said Longbottle, "darmat may be dead."

Jag made a noise like bubble wrap being burst, his snout vibrating as he did so. That was the one possibility he didn't want to consider. But the heat that close to the star would be incredible. The side of the darmat facing it might be over 350 degrees Celsius, hot enough to melt lead. Neither Jag nor Delacorte had yet worked out all the particulars of luster-quark meta-chemistry, but many normal complex molecules broke down when heated that high.

Another thought occurred to Jag. What, if any, funereal customs would the darmats have? Would they want this world-sized corpse brought home? He glanced at Longbottle. Dolphins just let the body float away when one of their own died. Jag hoped the darmats would be equally sensible.

"Let's head back," said Jag. "There's nothing we can do on our own."

The *Rum Runner* zoomed toward the shortcut in one of Longbottle's patented sweeping curves, hitting the point at the precise angle required to exit where they'd started all those jumps ago. *Starplex* was there, floating against the night, tinged green by the light of the fourth-generation star. Beyond it were the dark-matter beings, tendrils of gas stretching between them. The question now was what to do next. For one brief moment, Jag sympathized with Lansing. He wouldn't want to swim the choppy waters of the river that now spread out before the human.

Keith was in his apartment, preparing to leave for his upcoming meeting with Premier Kenyatta at Grand Central Station.

An electric bleep sounded. "Rhombus would like to see you," announced PHANTOM. "He requests seven minutes of your time."

Rhombus? Here? Keith really felt like being alone just now. He was marshaling his thoughts, trying to decide what to say in the meeting. Still, having an Ib disturb him at home was unusual enough to pique his curiosity. "The time is granted," said Keith—the appropriate answer dictated by Ibese manners.

PHANTOM again: "Since you are going to have an Ib visitor, may I dim the lights?"

Keith nodded. The ceiling panels decreased their intensity, and the glaring white glacier in the wall hologram of Lake Louise turned a muted gray. The double-pocket door slid aside and Rhombus rolled in. Lights flashed on his web. "Hello, Keith."

"Hello, Rhombus. What can I do for you?"

"Forgive me for intruding," said the pleasant British voice, "but you were quite angry on the bridge today."

Keith frowned. "Sorry if I was harsh," said Keith. "I was furious with Jag—but I shouldn't have taken it out on anyone else."

"Oh, your anger seemed quite focused. I doubt you gave offense."

Keith lifted his eyebrows. "Then what's the problem?"

Rhombus was quiet for a moment,

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then: "Have you ever thought about the apparent contradiction my race represents? We are obsessed, you humans say, with time. We hate to waste it. But we nonetheless spend time on being polite, and, as many humans have noted, we take pains not to hurt feelings."

Keith nodded. "I've wondered about that. Seems that wasting time on social niceties would take away from more important tasks."

"Precisely," said Rhombus. "Precisely the way a human would see it. But we do not perceive it that way at all. We see getting along as going—well, our metaphor is 'hub in wheel,' but you'd say 'hand in hand'—with a philosophy of not wasting time. A brief but unpleasant meeting ends up squandering more time than a longer but agreeable one."

"Why?"

"Because after an unpleasant encounter, one spends much time going over the meeting in one's mind, replaying it again and again, often seething over the things that were said or done." He paused. "You've seen with Boxcar that under Ibese jurisprudence, we punish direct wastings of time. If an Ib wastes ten minutes of my time, the courts may order that Ib's life shortened by ten minutes. But did you know that if an Ib upsets me through rudeness or ingratitude or deliberate maliciousness, the courts may impose a penalty of *sixteen* times the amount of time apparently wasted over the issue? We use a multiple of sixteen simply because, like the Waldahudin, that number is the base for our system of counting; there really is no way to quantify the time actually wasted mulling over an unpleasant experience. Years later, painful memories can—again, metaphors fail me. I would say 'roll up beside you'; you'd probably say 'rear their ugly head.' It is always better to leave a situation on pleasant terms, without rancor."

"You're saying we should really put the screws to the Waldahudin? Get back sixteen times what they did to us in damages?" Keith nodded. "That certainly makes sense."

"No, you miss my meaning—doubtless due to my lack of clarity in expressing it. I'm saying *forget* about what has transpired between you and Jag, and between Earth and Rehbollo. I despair over how much of your mental resources—how much of your *time*—you humans will waste over these issues. No matter how bumpy the terrain, smooth it in your mind." Rhombus paused for a moment, letting this sink in, then: "Well, I've used the seven minutes you granted me; I should leave now." The Ib began to roll away.

"People have died," said Keith, raising his voice. "It's not that easy to smooth it all out."

Rhombus stopped. "If it is difficult, it is only because you choose for it to be that way," he said. "Can you foresee any solution that will bring the dead back to life? Any reprisals that won't result in more people dead?" Lights played across his web. "Let it go."

Eta Draconis

Glass looked at Keith, and Keith

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looked at Glass. Something in the being's manner told Keith this would be their final conversation.

"You mentioned during your introductory speech that your Commonwealth currently consists of three homeworlds," said Glass.

Keith nodded. "That's right," he said. "Earth, Rehbollo, and Flatland."

Glass tipped his head. "There are, in fact, only seven thousand worlds with native life on them in this entire Universe at your time—and those few worlds are spread out over all the billions of galaxies. The Milky Way has far more than its fair share: during your time, there are a total of thirteen intelligent races within it."

"I'll keep score," said Keith, smiling. "I won't give up until we've found them all."

Glass shook his head. "You will *find them eventually, of course—when they're ready to be found. The shortcuts' facilitating of interstellar travel isn't just a side effect of their shunting stars back to the past. Rather, it's an integral part of the plan. But so is the safety valve that keeps sectors of space isolated until their native inhabitants become starfarers on their own. Of course, if you have the appropriate key, as I do, you can travel between any shortcuts, even apparently dormant ones. That's important, too, because we shortcut makers will need to make extensive use of them. But the way they work without the key is designed to foster an interstellar community, to give rise to the kind of peaceful and cooperative future that's in everyone's interest." Glass paused, and when he resumed speaking, his tone was a little sad. "Still, you won't be able to keep score of how many races you have yet to discover. When I send you back, I will wipe your memories of the time you've spent here."*

Keith's heart fluttered. "Don't do that."

"I'm afraid I must. We have an isolation policy."

"Do you—do you do this often? Grab people from the past?"

"Not as a rule, no, but, well, you're a special case. I'm *a special case."*

"In what way?"

"I was one of the first people to become immortal."

"Immortal. . . ." Keith's voice trailed off.

"Didn't I mention that? Oh, yes. You're not just going to live for a very long time—you're going to live forever."

"Immortal," said Keith again. He tried to think of a better word, but couldn't, and so simply said, "Wow."

*"But, as I said, you—I—*we *are a special case of immortality."*

"How so?"

"There are, in fact, only three older human beings than me in the entire Universe. Apparently, I had a—what do you call it?—an 'in' that got me the immortality treatments early on."

"Rissa was working on senescence research; I assume she ended up being co-developer of the immortality technique."

"Ah, that must have been it," said Glass.

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"You don't remember?"

"No—and that's the whole problem. You see, when they first invented immortality, it worked by allowing cells to divide an infinite number of times, instead of succumbing to preprogrammed cell death."

"The Hayflick limit," said Keith, having learned all about it in conversations with Rissa.

"Pardon?"

"The Hayflick limit. The phenomenon that limits the number of times a cell can divide."

"Ah, yes," said Glass. "Well, they overcame that. And they overcame the old, natural limitation that said you were born with a finite quantity of brain cells, and that those cells were not normally replaced. One of the keys to immortality was to let the brain constantly create new cells as the old ones wore out, so—"

"So if the cells are replaced," said Keith, eyes growing wide, "then the memories stored by the original cells get lost."

Glass nodded his smooth head. "Precisely. Of course, now we offload old memories into lepton matrices. We can remember an infinite amount of material. I don't just have access to millions of books, I actually remember the contents of millions of books that I've read over the years. But I became an immortal before *such offloading existed. My early memories—everything from my first couple of centuries of life—is gone."*

"One of my best friends," said Keith, "is an Ib named Rhombus. Ibs die when their early memories get wiped out—new memories overwrite their basic autonomous routines, killing them."

Glass nodded. "There's a certain elegance to that," he said. "It's very difficult to live without knowing who one is, without remembering one's own past."

"That's why you were disappointed that I'm only forty-six."

"Exactly. It means there's still a century and a half of my life that you can't tell me about. Perhaps someday, I'll locate another version of me, from—what would that be?—from about the year 2250 in your calendar." He paused. "Still, you remember the most crucial parts. You remember my physical childhood, you remember my parents. Until I spoke to you, I wasn't even sure that I'd had biological parents. You remember my first love. All of that has been gone from me for so incredibly long. And yet, those experiences shaped how I behave, set down the patterns of my personality, the core neural nets of my mind, the fundamentals of who I am." Glass paused. "I have wondered for millennia why I act the way I do, why I sometimes torture myself with unpleasant thoughts, why I interact with others as a bridge-builder or a peacemaker, why I internalize my feelings. And you have told me: I was once, long ago, an unhappy child, a middle child, a stoic child. There had been a horizon in my past, a curve beyond which I could not see. You have taken that away. What you have given me is beyond price." Glass paused, then his tone grew lighter. "I thank

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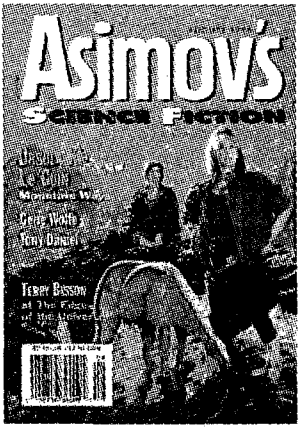

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you from the bottom of my infinitely regenerating heart."

Keith laughed, like a yelping seal, and the other Keith laughed too, like wind chimes, and then they both laughed at the sound the other had made.

"I'm afraid it's time for you to go home," said Glass.

Keith nodded.

Glass was silent for a moment, then: "I have refrained from giving you advice, Keith. It is not my place to do so, and, frankly, there are ten billion years between us. We are, in many ways, different people. What is right for me, now, at this stage of life, may not be right for you. But I owe you—for what you have given me, I owe you enormously, and I would like to repay you with a small suggestion."

Keith tilted his head, waited.

Glass spread his transparent arms. "I have seen the ebb and tide of human sexual morality over the eons, Keith. I've seen sex given as freely as a smile, and I've seen it guarded as though it were more precious than peace. I've known people who have been celibate for a billion years, and I've known others who have had more than a million partners. I've seen sex between members of different species from the same world, and between those who evolved on different worlds. Some people I know have removed their genitals altogether to avoid the issue of sex. Others have become true hermaphrodites, capable of procreative sex with themselves. Others still have switched genders—I have a friend who changes from male to female every thousand years, like clockwork. There have been times when humans have embraced homosexuality, and heterosexuality, and incest, and multiple concurrent spouses, and prostitution, and bestiality, and sadomasochism, and there have been times when all of those have been abjured. I have seen marriage contracts with expiration dates, and I have seen marriages last five billion years. And you, my friend, will live long enough to see all these things, too. But through all of it, there is one constant for people of conscience, for people like you and me: if you hurt someone you care about, there is guilt."

Glass dipped his head. "I do not remember Clarissa. I do not remember her at all. I have no idea what happened to her. If she, too, became an immortal, then perhaps she still exists, and perhaps I can find her. I have loved a thousand other humans over the years; a paltry number by many people's standards, but sufficient for me. But there is no doubt that Rissa must have been very, very special to us; that's apparent in the way you speak of her."

Glass paused, and Keith had the eerie feeling that eyes—invisible in that smooth transparent egg of a head—were seeking out his own, seeking the truth behind them. "I can read you, Keith. When you told me earlier to move along, to pick another topic, it was obvious what you were hiding, what you have been contemplating." A beat of silence; even the forest simulacrum around

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them held its peace. "Don't hurt her, Keith. You will only hurt yourself."

"That's the advice?" asked Keith.

Glass lifted his shoulders slightly. "That's it."

Keith was quiet for a time. Then: "How will I remember that? You said you were going to wipe my memories of this meeting."

"I will leave that thought intact. You will indeed have no memory of me, and you'll just think it came from yourself—which, of course, it did, in a way."

Keith thought for a time about what the appropriate reply was. Finally, he said, "Thank you."

Glass nodded. And then, sadly, he said, "It's time for you to go."

There was an awkward moment during which they stood and looked at each other. Keith started to extend his hand, but then let it drop to his side. Then, after a second of hesitation, he surged forward, and hugged Glass. To his astonishment, the transparent man felt soft and warm. The embrace lasted only a few seconds.

"Perhaps someday we'll meet again," said Keith, taking a step back now. "If you ever feel like popping through to the twenty-first century for a visit. . . ."

"Perhaps I will. We are about to start something very, very big here. I told you at the outset that the fate of the Universe is in question, and I—meaning you, too, of course—have a key role to play in that. I gave up being a sociologist ages ago. As you might guess, I've had thousands of careers over the millennia, and now I'm a—a physicist, you might call it. My new work will eventually necessitate a trip to the past."

"Just remember our full name, for God's sake," said Keith. "I'm listed in the Commonwealth directory, but you'll never find me again if you forget."

"No," said Glass. "This time I promise I will not forget you, or the parts of our past you have shared with me." He paused. "Good-bye, my friend."

The forest simulation—along with its motionless sun, daytime moon, and four-leaf lucky clovers—melted away, revealing the cubic interior of the docking bay. Keith started walking toward his travel pod.

Glass stood motionless in the bay as it opened to space. More magic; he needed no spacesuit. Keith touched a key, and his pod moved out into the night, the six-fingered pink nebula that had once been Sol staining the sky on his left, the robin's-egg-blue dragon receding behind him. He flew the pod toward the invisible point of the shortcut, and as he made contact, he felt a faint itching inside his skull. He had just been thinking about—about something. . . .

It was gone now, whatever it had been.

Oh, well. The ring of Soderstrom radiation passed over the pod from bow to stern, and Keith's view was filled with the sky of Tau Ceti, Grand Central Station visible off to his right, looking odd in the dim red light from the newly arrived dwarf star.

As he always did when he came here, Keith amused himself for a few

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seconds finding Boötes, then locating Sol. He nodded once and smiled. Always good to know that the old girl hadn't gone nova. . . .

CHAPTER 23

Keith had always thought Grand Central Station looked like four dinner plates arranged in a square, but today, for some reason, it reminded him of a four-leaf clover floating against the stars. Each of the leaves or plates was a kilometer in diameter and eighty meters thick, making the station the largest manufactured structure in Commonwealth space. Like *Starplex*'s own much-smaller central disk, the outward facing edges of the plates were studded with docking-bay doors, many of them bearing the logos of Earth-based trading corporations. The computer aboard Keith's travel pod received docking instructions from Grand Central's traffic controller, and flew him in toward a docking ring adjacent to a large corrugated space door bearing the yellow-script symbol of the Hudson's Bay Company, now in its fifth century of operation.

Keith looked around through the travel pod's transparent hull. Dead ships were floating across the sky. Tugs were arriving at the docking bays, hauling wreckage. One of the station's four plates was completely dark, as if it had taken a major hit during the battle.

Once his pod was secured, Keith exited into the station. Unlike *Starplex*, which was a Commonwealth facility, Grand Central belonged entirely to the peoples of Earth, and its common environment was kept precisely at terrestrial standard.

A governmental aide was waiting to greet Keith. He had a broken arm. It had likely occurred during the battle with the Waldahudin, since the bone-knitting web he had on would normally only be worn for seventy-two hours after the injury. The aide took him to the opulent office of Petra Kenyatta, Human Government premier of Tau Ceti province.

Kenyatta, an African woman of about fifty, rose to greet Keith. "Hello, Dr. Lansing," she said, extending her right hand.

Keith shook it. Her grip was firm, almost painfully so. "Ma'am."

"Please, have a seat."

"Thank you." No sooner had Keith sat down in the chair—a regular, non-morphing human chair—than the door slid open again and another woman came in, this one Nordic in appearance and a little younger than Kenyatta.

"Do you know Commissioner Amundsen?" said the premier. "She's in charge of the United Nations police forces here at Tau Ceti."

Keith half rose from his chair. "Commissioner."

"Of course," said Amundsen, taking a seat herself, "'police forces' is a euphemism. We call it that for alien ears."

Keith felt his stomach knotting.

"Reinforcements are already on their way from Sol and Epsilon Indi," said Amundsen. "We'll be ready to move on Rehbollo as soon as they arrive."

"Move on Rehbollo?" said Keith, shocked.

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"That's right," said the commissioner. "We're going to kick those bloody pigs halfway to Andromeda."

Keith shook his head. "But surely it's over. A sneak attack only works once. They're not going to be coming back."

"This way we make sure of that," said Kenyatta.

"The United Nations can't have agreed to this," said Keith.

"Not the United Nations, of course," said Amundsen. "Dolphins don't have the spine for something like this. But we're sure the HuGo will vote for it."

Keith turned to Kenyatta. "It would be a mistake to let this escalate, premier. The Waldahudin know how to destroy a shortcut."

Amundsen's sapphire eyes went wide. "Say that again."

"They could cut us off from the rest of the Galaxy—and they only need to get one ship through to Tau Ceti to do that."

"What's the technique?"

"I—I have no idea. But I'm assured it works."

"All the more reason to destroy them," said Kenyatta.

"How did they sneak up on you?" asked Commissioner Amundsen. "Here at Tau Ceti, they sent one large mothership through, and it disgorged fighters as soon as it arrived. I understand from what Dr. Cervantes said while she was here that they sent individual craft after *Starplex*. How was it that you didn't notice when the first one arrived?"

"The newly emerged star was between us and the shortcut."

"Who ordered the ship to take that position?" asked Amundsen.

Keith paused. "I did. I give all the orders aboard *Starplex*. We were engaged in astronomical research, and had to move the ship away from the shortcut to facilitate that. I take full responsibility."

"No need to worry," said Amundsen, grinning like a skull. "We'll make the pigs pay."

"Don't call them that," said Keith, surprising himself.

"What?"

"Don't call them that name. They are Waldahudin." He managed to say the word as a bark, with perfect accent and asperity.

Amundsen was taken aback. "Do you know what they call us?" she asked.

Keith shook his head slightly.

"Gargtelktn," she said. "'Ones who copulate out of season.'"

Keith suppressed a grin. But then he sobered. "We can't go to war with them."

"They started it."

He thought of his older sister and younger brother. He thought of an old black-and-white movie with dueling anthems, the *Marseillaise* drowning out *Wacht am Rhein*. And he thought, most of all, of the sight of the young Milky Way, cupped in his outstretched hand.

"No," said Keith simply.

"What do you mean, 'no'?" snapped Amundsen. "They did start it."

"I mean it doesn't make any difference. None of it does. There are beings out there made of dark matter. There are shortcuts in intergalactic

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space. There are stars coming back from the future. And you're worried about who started it? It doesn't matter. Let's end it. Let's end it here and now."

"That's exactly what we're talking about," said Premier Kenyatta. "Ending it once and for all. Knocking the pigs on their hairy asses."

Keith shook his head. Mid-life crisis—for all of them, humans and Waldahudin. "Let me go to Rehbollo. Let me talk to Queen Pelsh. I'm supposed to be a diplomat. Let me go and talk peace. Let me build a bridge."

"People have died," said Amundsen. "Here at Tau Ceti, humans beings have died."

Keith thought of Saul Ben-Abraham. Not the horrid picture that usually came to mind, Saul's skull opening like a red flower in front of his eyes, but rather Saul alive, great wide grin splitting his dark beard, a home-brewed beer in hand. Saul Ben-Abraham had never wanted war. He'd gone to the alien ship looking for peace, for friendship.

And what about the other Saul? Saul Lansing-Cervantes—unable to carry a tune, sporting a silly goatee, shortstop on one of Harvard's campus baseball teams, a chocoholic—and a physics major, the kind they would draft to be a hyperdrive pilot if it came to war.

"Humans have died before, and we have not sought vengeance," said Keith. Rhombus had been right. Let it go, he'd said. Let it all go. Keith felt it leaving him, the unpleasant thing he'd carried around for eighteen years. He looked at the two women. "For the sake of those who have died—and for all those who *would* die in a war—we have to put out the fire before it's too late."

Keith reboarded his travel pod, left Grand Central, and headed back toward the shortcut.

He had spent hours arguing with Commissioner Amundsen and Premier Kenyatta. But he wouldn't give up. *This* was the windmill he'd been looking for. This was the battle worth fighting—the battle for peace.

An impossible dream?

He thought of his great-great-grandfather's wonder-filled life. Cars and airplanes, lasers and Moon landings.

And his own wonder-filled life.

And all the wonders yet to come.

Nothing was impossible—not even peace. Any sufficiently advanced technology is indistinguishable from magic.

Sufficiently advanced. Races *did* grow up, did enter a state of maturity. He was ready for that. At last, he was ready.

Others must be, too.

Borman, Lovell, and Anders had cupped the Earth in their hands. Just a quarter of a century later, that same world had begun disarming itself. Einstein hadn't lived to see it, but his impossible dream of putting his nuclear genie back in the bottle *had* come to pass.

And now humans and Waldahudin had both cupped the Galaxy in their hands. A Galaxy that Keith, and surely others, would live to see rotate around its axis time and again.

There would be peace between the races. He would make sure of that. Af-

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ter all, what better job was there for a middle child with billions of years to spend?

Keith's travel pod touched the shortcut, the purple halo passed over the spherical hull, and he emerged back near the green star.

Starplex was up ahead, a giant silver-and-copper diamond against the starry backdrop. Keith could see that docking bay seven's space door was open, and the bronze wedge of the *Rum Runner* was in the process of landing—meaning Jag and Longbottle must be returning with news of their search for the darmat baby. Heart pounding, Keith activated his pod's preprogrammed docking sequence.

Keith hurried to the bridge. Although he'd only been gone a short time, he felt a need to hug Rissa, who happened to be there using her console even though it was delta shift. He held her tight for several seconds, feeling the warmth of her. Wineglass politely rolled away from the director's workstation in case Keith wished to use it, but Keith motioned for the Ib to return to it, and Keith took a chair in the seating gallery at the back of the room.

No sooner had he done so than the forward bridge door opened and Jag waddled in. "The baby is trapped," he barked as he made his way over to the physics station, which was currently unoccupied. "It's stuck in close orbit around a star that emerged from the same shortcut the baby did."

"Did you call out to it by radio?" asked Rissa. "Any response?"

"None," said Jag, "but the star is a real noisemaker. Our message might have been lost going in, or the reply might have been lost coming out."

"It would be like trying to hear a whisper during a hurricane," said Keith, shaking his head. "All but impossible."

"Especially," said Longbottle, popping up in the starboard pool on the bridge, "if the darmat is dead."

Keith looked at the dolphin's face, then nodded. "That's a good point. How do we tell if something like that is still alive?"

Rissa frowned. "None of us would survive five seconds close to a star without a lot of shielding or heavy-duty force screens. The baby is naked."

"It's worse than that," said Jag. "The thing is *black*. Although the luster-quark matter is transparent to electromagnetic radiation, the regular-matter dust that permeates it is not reflecting any appreciable amount of the star's light and heat. The child may be cooking itself."

"So what do we do?" asked Keith.

"First," said Jag, "we should get it into the shade—build a reflective foil parasol that could be jockeyed in between the darmat and the star."

"Can our nanotech lab do that here?" asked Keith. "Ordinarily, I'd have New Beijing build such a thing and shunt it through the Tau Ceti shortcut to us, but I saw the mess they were in when I popped back for my meeting."

There was a young Native American sitting at InOps. "I'd have to check with Lianne to be sure," he said, "but I suspect we can pull it off.

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It won't be easy, though. The parasol will have to be over a hundred thousand klicks wide. Even at just one molecule of thickness, that's still a lot of material."

"Get to work on it," said Keith. "How long?"

"Six hours if we're lucky," said the man. "Twelve if we're not."

"But even if we shield the baby, then what?" asked Rissa. "It's still trapped."

Keith looked at Jag. "Could we use the parasol as a solar sail, and let the solar wind blow it away from the star?"

Jag snorted. "Ten to the thirty-seventh kilos? Not a chance."

"OK, OK—what about this?" said Keith. "What if we protect the baby with some sort of force shield, and then detonate the star, so that it goes nova, and—"

Jag was barking in a staccato pattern—Waldahud laughter. "Your imagination is unbridled, Lansing. Oh, there has been some theoretical work on controlled nova reactions—I've been exploring that area a bit myself—but there's no shield we could build that would protect the baby from a star going nova only forty million kilometers away."

Keith was not to be deterred. "OK, try this: suppose we force the new star back through the shortcut. When it passes through the shortcut, its gravitational pull will disappear, and the baby goes free."

"The star is moving *away* from the shortcut, not toward it," said Jag. "We cannot move the shortcut at all, and if we had the power to turn a star around, we would also have the power to skim a Jupiter-sized object out of a close orbit around the star. But we don't." Jag looked around the room. "Any more bright ideas?"

"Yes," said Keith, after a moment. He looked directly at Jag. "Yes, indeed!"

When Keith had finished talking, Jag's mouth hung open for a few moments, showing the two curving blue-white translucent dental plates within. Finally, he barked in a subdued fashion. "I—I know I said such things were possible, but it has never been tried on anything approaching this scale."

Keith nodded. "Understood. But unless you have a better suggestion—"

"Well," said Jag's Brooklynite voice, "we could leave the darmat baby in orbit around the star. Assuming it is still alive, once we put the parasol sun-shield in place, it could, in theory, live out the rest of its natural life—however long *that* is—in close orbit around that star. But if your plan does not work, the darmat child will be killed." Jag's voice became quieter. "I know, Lansing, that I am the one always looking for glory—and, since my role in what you propose is pivotal, I have no doubt that considerable glory would accrue to me were we able to pull this off. But it really is not our decision to make. Ordinarily, I'd say ask the—the *patient*—for permission before attempting something as risky as this, but that is not possible in this case, because of the radio noise. And so I suggest we do what both your race and mine would do in

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such circumstances: we should ask the next of kin."

Keith thought about that, then began to nod slowly. "You're right, of course. I keep seeing the macro-issue, that if we pull this off, it'll be great for our relationships with the darmats. Damn, sometimes I'm pretty pigheaded."

"That is all right," said Jag lightly, choosing not to take offense at Keith's unfortunate choice of words. "Rumor has it that you are going to have a very long time to acquire more wisdom."

Keith spoke into the mike. "*Starplex* to Cat's Eye. *Starplex* to Cat's Eye."

The incongruous French accent; Keith half expected the thing to say *Bonjour*. "Hello, *Starplex*. It is wrong to ask, but. . . ."

Keith smiled. "Yes, we have news of your child. We have located it. But it is in close orbit around a blue star. It is unable to get away under its own power."

"Bad," said Cat's Eye. "Bad."

Keith nodded. "But we have a plan that may—I repeat, may—allow us to rescue the child."

"Good," said Cat's Eye.

"The plan involves much risk."

"Quantify."

Keith looked at Jag, who lifted all four shoulders. "I can't," said the human. "We've never done anything like this on this scale before. Indeed, I only recently learned that it was theoretically possible. It may work, or it may not—and I have no way of knowing the likelihood of either outcome."

"Better idea available?"

"No. No, in fact, this is our *only* idea."

"Describe plan."

Keith did so, at least as much as the limited vocabulary they had established allowed.

"Difficult," said Cat's Eye.

"Yes."

There was a long period of silence on the frequency used by Cat's Eye, but lots of traffic on the other channels—the darmat community discussing its options.

At last, Cat's Eye spoke again. "Try, but . . . but . . . two hundred and eighteen minus one is much less than two hundred and seventeen."

Keith swallowed. "I know."

The *PDQ* (containing the cetacean physicist Melondent) and the *Rum Runner* (with Jag and Longbottle aboard) headed through the shortcut to the sector containing the darmat baby. Working in tandem, the two ships deployed the molecule-thick parasol. Reaction motors were mounted on the parasol's frame, firing away from the blue star to keep the solar wind from blowing it away. Once the baby was in the shade, its nearside surface temperature began to drop rapidly.

Next, 112 hastily constructed buoys, each consisting of a hollowed-out watson casing with special equipment mounted inside, were popped through the shortcut from *Starplex*. The two probeships used their tractor beams to array them in interlocking orbits around the baby.

On one of his tall, thin monitor screens aboard the *Rum Runner*, Jag

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displayed a hyperspatial map showing the steep local gravity well with the star at the bottom. The sides of the well were almost perpendicular this close to the star; they only began to flare out just before the orbiting darmat was encountered. The baby made a second, smaller well of its own.

Once the buoys were in place, the *PDQ* headed off, moving past the shortcut without going through it, and continuing on for half a day. Finally, they were all lined up in a neat row. At one end was the *Rum Runner*. Next to it was the darmat baby. Forty million kilometers beyond the baby was the fiery blue star. Three hundred million kilometers farther on was the shortcut, and a billion kilometers beyond that was the *PDQ*—Melondent was now a total of seventy-two light-minutes from the star, far enough away that her local space was now reasonably flat.

"Ready?" barked Jag to Longbottle, in the *Rum Runner*'s piloting tank.

"Ready," the dolphin barked back in Waldahudar.

Jag touched a control, and the lattice of buoys surrounding the darmat baby sprang to life. Each buoy contained an artificial-gravity generator, powered by solar energy stolen from the very star they were trying to fight. Slowly, in unison, the buoys increased their output, and, just as slowly, a flattening pocket began to develop in one wall of the star's steep gravity well.

"Gently," said Jag, under his breath, watching his hyperspace map. "Gently."

The pocket continued to grow more and more flat. Great care had to be taken to not flatten out the darmat's own gravity well: if the effects of the baby's own mass were suppressed—which, after all, was what was holding it together—it would lose cohesion, and expand like a balloon.

The buoys' output continued to grow and the curvature of space-time continued to diminish, until, until—

Flatness, like a plateau jutting from the side of the well. It was as if the darmat were in interstellar space, not spitting distance from a star.

"Isolation complete," said Jag. "Now let's get it out of there."

"Activating hyperdrives," said Longbottle.

The antigrav buoys made up points on a sphere around the baby, but now, as their individual hyperspace field generators came on, that whole sphere seemed to mirror over, as if it were a glob of mercury floating freely in space. In a matter of seconds, the glob shrank to nothingness and disappeared.

The buoys were preprogrammed to run the darmat baby away from the blue star as fast as possible. The *PDQ* was waiting near the point at which the darmat should emerge from hyperspace, far enough from the star that the hyperdrive field should collapse without difficulty.

The *Rum Runner* set out for the same location, traveling under thruster power. As they passed near the shortcut point, a radio message from Melondent came through, blue-shifted because of the *Rum Runner*'s acceleration toward her ship.

"*PDQ* to Longbottle and Jag. Arrived has darmat baby; popped into

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normal space it did right in front of my eyes. Hyperdrive field collapse uneventful was. But baby shows still no signs of life, and responds does not to my hails."

Jag's fur moved pensively. No one had known for sure whether the baby would survive unprotected during its brief journey through hyperspace. Even if it had been alive beforehand, that might have killed it. Maddeningly, there was no way to tell.

The space-flattening technique *was* risky. Rather than use it themselves so that Longbottle could engage the *Rum Runner*'s hyperdrive, they flew out to their rendezvous with the *PDQ* under thruster power. To fill the time, and to get his mind off the fate of the baby, Jag spoke with Longbottle, who, to his credit, was piloting the ship in an absolutely straight line.

"You dolphins," said Jag, "like the humans."

"Mostly," said Longbottle in high-pitched Waldahudar. He let the piloting drones disengage from his fins, and put the ship on automatic.

"Why?" barked Jag, sharply. "I have read Earth history. They polluted the oceans you swam in, captured you and put you in tanks, caught you in fishing nets."

"No one of them has done any of that to me," said Longbottle.

"No, but—"

"It is the difference: we generalize do not. Specific bad humans did specific bad things; those humans do we not like. But the rest of humanity we judge one by one."

"But surely once they discovered you were intelligent, they should have treated you better."

"Humans discovered intelligent we were before we discovered that they were."

"What?" said Jag. "But surely it was obvious. They had built cities and roads, and—"

"Saw none of that."

"No, I suppose not. But they sailed in boats, they built nets, they wore clothes."

"None of those were meaningful to us. We had of such things no concept; nothing to compare them to. Mollusk grows a shell; humans have clothes of fabric. The mollusk's covering is stronger. Should judged we have the mollusk more intelligent? You say humans built things. We had no concept of building. We knew not they made the boats. We thought perhaps boats alive were, or had once been alive. Some tasted like driftwood, others ejected chemicals into the water, just as living things do. An achievement, to ride on the back of boats? We thought humans were like remoras to the shark."

"But—"

"They our intelligence did not see. They looked right at us and see it did not. And we looked at them and did not see theirs."

"But after you discovered their intelligence, and they yours, you must have realized they had been mistreating you."

"Yes, some in the past mistreated us. Humans *do* generalize, they blamed themselves. Learned have I since that concept of ancestral guilt—original sin—is to many of their beliefs central. There were cases in hu-

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man court to determine compensation due to dolphins. This made to us no sense."

"But you get along with humans now, which is something my people are having trouble managing. How do you do it?"

Longbottle barked, "Accept their weaknesses, welcome their strengths."

Jag was silent.

Finally, the *Rum Runner* reached its destination, 1.3 billion kilometers from the star, and a billion kilometers past the shortcut. Jag and Melondent consulted by radio about the exact trajectory they wanted to launch the darmat child on, then the gravitational buoys were activated again, pushing and pulling the world-sized being, which, as planned, started to fall in toward the star, sliding back down the gravity well it had earlier been whisked out of. But this time, the shortcut point was in between the darmat and the star; this time, if all went well, the child would touch the shortcut, its approach to it speeded somewhat by the attraction of the star's gravity beyond.

Even at full thrusters, it took more than a day for the buoys to bring the darmat back in to the vicinity of the shortcut. Melondent popped a watson through to *Starplex,* warning them that, if all went well, the baby was about to re-emerge on their side.

When they did get close to the shortcut, the buoys fought to slow down the baby's speed, so that it would pass slowly through the portal. The whole rescue effort would be for naught if the darmat ended up whipping in toward the green star near *Starplex*. Once it had been braked to a reasonable speed, they adjusted the baby's trajectory so that it would pass through the tachyon sphere on the precise course required.

First to pass through the shortcut were some of the gravity buoys, then, at last, the baby itself touched it. The point began to swell, widening, enveloping the darmat, lips of purple lightning surrounding then engulfing the giant black sphere. Jag wondered what was going through the darmat's mind during the passage, assuming it was still alive.

And if it was alive, and did at some point regain whatever passed for consciousness, then, Jag wondered, what if it panicked? What if it was unable to make sense out of being partly in one sector of space and partly in another? It might grind its own passage to a halt. If the beast were to expire there, halfway through the shortcut, there might be no way to dislodge it. The shortcut opening formed a tight seal around the passing body, so no coordination of the use of gravity generators on both sides would be possible. And that would mean that the *Rum Runner* and the *PDQ* might be trapped forever here, out on the edge of the Perseus arm, tens of thousands of light-years from any of the homeworlds.

The darmat was deforming a bit as it moved through the opening, the shortcut's periphery clamping down on it. Such clamping was normal, and the effect on rigid spaceships was negligible, but the darmat was mostly gas—exotic, luster-quark gas to be

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sure, but still gas. Jag feared the baby would be cleaved in two—similar to the normal birthing process, but possibly fatal when done unexpectedly. But it seemed the creature's core was sufficiently solid to prevent the shortcut from pinching all the way through.

At last, the darmat completed its passage. The shortcut collapsed down to its normal dimensionless existence. Jag wanted Longbottle to immediately dive through the shortcut, so that they could see the result of all their efforts. But they, and Melondent aboard the *PDQ*, had to wait for hours to be sure the darmat had moved far enough from the shortcut so that a collision—or just tidal stress from its enormous gravity—wouldn't destroy their ships when they popped through to the other side.

At last, after a probe had indicated it was safe to go through, Longbottle programmed the computer to take them home. The *Rum Runner* moved forward. The shortcut swelled, and they passed through to the other side.

It took Jag a few moments to take in all that he was seeing. The baby was there, all right. And so was *Starplex*. But *Starplex* was surrounded on all sides by darmats, and the ship itself looked dead, all the lights in its windows dark.

CHAPTER 24

The shortcut point began to expand, starting as a violet pinprick of Soderstrom radiation, and growing as an ever-expanding purple ring. First to pop through was one of *Starplex*'s hastily constructed antigravity buoys, and then another and another. They zoomed across the sky like bullets. They'd been tugging the darmat baby, but, since they came through the portal before it did, they were severed from its mass and so shot ahead. Soon, though, the bulk of the darmat baby began its passage, bulging out through the ring of purple in the sky.

On *Starplex*'s bridge Thorald Magnor let loose a great cheer, and it was echoed by hundreds of others from all over the ship, as everyone watched the spectacle either through a window or on a viewscreen.

Cat's Eye and a dozen other adult darmats moved closer to the shortcut, calling out to the baby. Over the bridge speakers, PHANTOM played a translation of what Cat's Eye was saying, but many of the words were missing; the leader of the darmats was not limiting his vocabulary to the few hundred words Rissa and Hek had learned. "Come forward . . . forward . . . toward . . . you are . . . we . . . come . . . hurry . . . do not . . . forward . . . forward. . . ."

Rhombus was using the deck-one array to monitor the emerging baby, but so far it hadn't transmitted a word of its own, at least not on any frequency even close to the 21-centimeter band.

Lianne Karendaughter was shaking her head. "It's not moving at all under its own volition," she said. "It must be dead."

Keith ground his teeth together. If it was dead, all this was for nothing—"It's possible," he said, at last, trying as much to convince himself as

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Lianne, "that a single darmat can't move on its own. They may need to play off each other's gravity and repulsion. The baby may not yet be far enough out for that."

"Forward," said Cat's Eye. "Forward . . . come . . . you . . . forward."

Keith had never heard of anyone trying so slow a passage through a shortcut before—there was an unspoken sense that one should hurry through, that to tarry would be tempting fate, lest the magic of the thing fail.

At last the baby completed its passage. The shortcut collapsed, although, moments later, it opened slightly several times as additional antigrav buoys popped through from the other side.

The darmat child was moving away from the shortcut, but only under momentum. It had not yet—

"Where . . . where. . . ."

Still a French-accented voice, but, in a stroke of rare creativity, PHANTOM had chosen a child's tones for this translation.

"Home . . . back. . . ."

Thor let loose another thunderous cheer. "It's alive!"

Keith found his eyes misting over. Lianne was openly crying.

"It's alive!" Thor shouted again.

The darmat baby did, finally, begin to move, heading towards Cat's Eye and the others.

The speakers changed back to the voice PHANTOM had assigned to Cat's Eye. "Cat's Eye to *Starplex*," it said.

Keith keyed his mike. "*Starplex* responding," he said.

Cat's Eye was quiet longer than the round-trip signal time would have required, as if he was searching for a way to express what he wanted to say using the limited vocabulary available. Finally, simply, he said, "We are friends."

Keith felt himself grinning from ear to ear. "Yes," he said. "We are friends."

"The child's vision is damaged," said Cat's Eye. "It will . . . become equal to one again, but time is required. Time, and absence of light. Green star is bright; not here when child left."

Keith nodded. "We can build another shield, to protect the baby from the green star's light."

"More," said Cat's Eye. "You."

Keith was momentarily puzzled. "Oh—of course. Lianne, kill all our running lights, and, after warning people, douse the lights in all rooms with windows. If people want to put their lights back on, tell them to draw the shades first."

Lianne's beautiful face was split by a wide smile. "Doing so."

Starplex went dark, and the darmat community moved toward the great ship and their newly returned child.

The *Rum Runner* popped through the shortcut, followed moments later by the *PDQ*. Radio communication soon assured their crews that *Starplex* was all right, and the ships curved in toward the docking bays. As soon as the *Rum Runner* was safely aboard, Jag headed for the bridge.

Keith was still talking to Cat's Eye

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when Jag entered the bridge. The director turned to the Waldahud. "Thank you, Jag. Thank you very much."

Jag nodded his head, accepting the comment.

The voice of Cat's Eye came over the speakers. "We to you an incorrect," he said.

A wrong, thought Keith. They did us wrong.

"You into point that is not a point had to move with high speed."

"Oh, it wasn't so bad," said Keith, ever the diplomat, into the mike. "Because of that we got to see our group of hundreds of millions of stars."

"We call such a group a"—PHANTOM translated the new signal—*"galaxy."*

"You have a word for galaxy?" said Keith, surprised.

"Correct. Many stars, isolated."

"Right," said Keith. "Well, the shortcut put us six billion light-years from here. That meant we were seeing our Galaxy as it looked six billion years ago."

"Understand looking back."

"You do?"

"Do."

Keith was impressed. "Well, it was fascinating. Six billion years ago, the Milky Way didn't have its current shape. Um, I guess you don't know this, but it's currently shaped like a spiral." A light flashed on Keith's console, PHANTOM notifying him that he'd just used a word for which there was as yet no darmat equivalent in the translation database. Keith nodded at PHANTOM's cameras. "A spiral," he said into the mike, "is . . . is . . ." He sought a metaphor that would be meaningful; terms such as "pinwheels" would convey no information to the darmat. "A spiral is. . . ."

PHANTOM provided a definition on one of Keith's monitor screens. He read it into the mike. "A spiral is the path made by an object rotating around a central point while also receding from that point at a constant speed."

"Understand spiral."

"Well, the Milky Way is a spiral, with four major"—he wanted to say "arms," but again that was a useless word—"parts."

"Know this."

"You do?"

"Made."

Keith looked at Jag, who moved his lower shoulders up and down in a shrug. What did the darmat mean? That he'd been made to learn this fact in some dark-matter equivalent of grammar school?

"Made?" repeated Keith.

"Once plain, now . . . now . . . no word," said the darmat.

Lianne spoke up. "Now *pretty,*" she said. "That's the word he's looking for, I bet."

"To look at it, one plus one greater than two?" asked Keith into the mike.

"Greater than. More than sum of its parts. Spiral is. . . ."

"Is *pretty,*" said Keith. "More than the sum of its parts, visually."

"Yes," said Cat's Eye. "Pretty. Spiral. Pretty."

Keith nodded. There was no doubt that spiral galaxies were more interesting to look at than elliptical ones. Keith was pleased that humans and

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darmats apparently shared some notion of esthetics, too. Not too surprising, though, given that many artistic principles were based on mathematics.

"Yes," said Keith. "Spirals are very pretty."

"That why we make them," said the synthesized voice from the speaker.

Keith felt his heart jump, and he saw Jag do a reflexive splaying of all sixteen of his fingers, the Waldahud equivalent of a double take.

"You make them?" said Keith.

"Affirm. Move stars—small tugs, takes long time. Move stars into new patterns, work to hold them there."

"You turned our Galaxy into a spiral?"

"Who else?"

Who else indeed . . . ?

"That's incredible," said Keith, softly.

Jag was rising from his chair. "No, that makes sense," the Waldahud said. "By all the gods, that makes sense. I said there was no good theory for explaining why galaxies acquired or maintained spiral shapes. Being deliberately held in place by conscious dark matter—it's mind-boggling, but it *does* make sense."

Keith keyed off the mike. "But—but what about all the other galaxies? You said three-quarters of all galaxies are spirals."

Jag did a four-armed Waldahud shrug. "Ask it."

"Did you make many galaxies into spirals?"

"Not us. Others."

"I mean, did others of your kind make many galaxies into spirals?"

"Yes."

"But why?"

"Have to look at them. Make pretty. Make—make—a thing for expressions not mathematic."

"Art," said Keith.

"Art, yes," said Cat's Eye.

Having left his chair, Jag now dropped down to all fours, the first time Keith had ever seen him do that. "Gods," he barked, his voice subdued. "Gods."

"Well, it certainly fills that theoretical hole you were talking about," said Keith. "It even explains that bit you mentioned about ancient galaxies seeming to rotate faster than theory suggests they should. They were being *made* to rotate, in order to spin out spiral arms."

"No, no, no," barked Jag. "No, don't you understand? Don't you see? It's not just an esoteric point of galaxy formation that's been explained. We owe them everything—everything!" The Waldahud took hold of one of the metal legs supporting Keith's console and hauled himself back onto two feet again. "I told you earlier: stable genetic molecules would have an almost impossible time existing in a densely packed mass of stars, because of the radiation levels. It's *only* because our homeworlds exist far from the core, out in the spiral arms, that life was able to arise on them at all. We exist—all the life made out of what we arrogantly refer to as 'regular matter'—all of it exists simply because the dark-matter creatures were playing with stars, swirling them into pretty patterns."

Thor had turned around to face Jag. "But—but the biggest galaxies in the

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Universe are ellipticals, not spirals."

Jag lifted his upper shoulders. "True. But maybe shaping them is too much work, or too time consuming. Even with faster-than-light communications—with 'radio-two'—it would still take tens of thousands of years for signals to pass from one side of a truly giant elliptical to the other. Maybe that's too much for a group effort. But for mid-sized galaxies like ours and Andromeda—well, every artist has a preferred scale, no? A favorite canvas size, or an affinity for either short stories or novels. Mid-sized galaxies are the medium . . . and . . . and *we* are the message."

Thor was nodding. "Jesus, he's right." He looked at Keith. "Remember what Cat's Eye said when you asked it why it tried to kill us? 'Make you. Not make you.' My father used to say that, too, when he was angry: 'I brought you into this world, boy, and I can take you out of it.' They *know*—the darmats know that their activity is what has made our kind of life possible."

Jag was losing his balance again. He finally gave up, and dropped back to his four hind legs, making him look like a chubby centaur. "Talk about an ego blow," he said. "This one is the biggest of them all. Early on, each of the Commonwealth races had thought its homeworld was the center of the Universe. But, of course, they weren't. Then we reasoned that dark matter must exist—and, in a way, that was even more humbling. It meant that not only were we *not* the center of the Universe, we're not even made out of what most of the Universe is made from! We are like the scum on a pond's surface daring to think that we are more important than all the vast bulk of water that makes up the pond.

"And now this!" His fur was dancing. "Remember what Cat's Eye said when you asked it how long ago dark-matter life had first arisen? 'Since the beginning of all the stars combined,' he said. 'Since the beginning of the Universe.'"

Keith nodded.

"He said they *had* to exist that far back—had to!" Jag's fur was rippling. "I thought it was just a philosophical position, but he's right, of course—life had to exist from the beginning of this Universe, or as near to the beginning as physically possible."

Keith stared at Jag. "I don't understand."

"What arrogant fools we are!" said Jag. "Don't you see? To this day, despite all the humbling lessons the Universe has already taught us, we still try to retain a central role in creation. We devise theories of cosmology that say the Universe was destined to give rise to us, that it had to evolve life like us. Humans call it the anthropic principle, my people called it the *aj-Waldahudigralt* principle, but it's all the same thing: the desperate, deep-rooted need to believe that we are significant, that we're important.

"We talk in quantum physics about Schrödinger's cat or Teg's *kestor*—the idea that everything is just potentialities, just wavefronts, unresolved, until one of us all-important qualified observers lumbers by, has a peek, and, by the process of looking, causes the

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wavefront to collapse. We actually allowed ourselves to believe that that is how the Universe worked—even though we know full well that the Universe is many billions of years old, and not one of our races is more than a million.

"Yes," barked Jag, "quantum physics demands qualified observers. Yes, intelligence is necessary to determine which possibility becomes reality. But in our arrogance we thought that the Universe could work for fifteen billion years without us, and yet that it somehow was geared to give rise to us. Such hubris! The intelligent observers are not us—tiny beings, isolated on a handful of worlds in all the vastness of space. The intelligent observers are the dark-matter creatures. They have been spinning galaxies into spirals for billions upon billions of years. It is their intellect, their observations, their sentience that drives the Universe, that gives quantum potentialities concrete reality. We are *nothing*—nothing!—but a recent, localized phenomenon—a spot of mold on a Universe that doesn't need us, or care that we exist. Cat's Eye was absolutely right when he said we were insignificant. This is *their* universe—the darmats' universe. They made it, and they made us, too!"

CHAPTER 25

Keith sat in his office on deck fourteen, looking over the latest news from Tau Ceti. Reports were sketchy, but on Rehbollo, forces loyal to Queen Trath had put down the insurrection against her, and twenty-seven conspirators had been summarily executed in the traditional method of being drowned in boiling mud.

Keith set down the datapad. The report strained credulity—it was the first he'd heard of any political unrest on Rehbollo. Still, maybe it was true—although more likely it was just a government desperately trying to distance itself from a disastrous initiative.

A chime sounded, and PHANTOM's voice said, "Jag Kandaro em-Pelsh is here."

Keith exhaled. "Let him in."

Jag entered and found a polychair. His left eyes were on Keith, but the right pair were scanning the room in the instinctive fight-or-flight pattern. "I suppose at this juncture," he said, "I must fill out some of those forms you humans are so fond of."

"What forms?" said Keith.

"Forms for resigning my position aboard *Starplex,* of course. I can no longer serve here."

Keith rose to his feet, and permitted himself a stretch.

It had to begin somewhere—maturity, the stage after the mid-life crisis, peace. It had to begin somewhere.

"Children play with toy soldiers," said Keith, looking now at Jag. "Child races play with real ones. Maybe it's time all of us grew up a bit."

The Waldahud was quiet for a long moment. "Maybe."

"We all have loyalties hard-wired into our genes," said Keith. "I won't push for your resignation."

"Your comments assume that I am guilty of something. I reject that. But were it true, you still misunderstand. Perhaps . . . perhaps your people will

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always misunderstand mine." Jag paused. "And the converse, too, of course." Another pause. "No, it is time for me to return to Rehbollo."

"There's a lot of work left to be done here," said Keith.

"Doubtless so. But the job I set for myself has been completed."

"Oh," said Keith, understanding dawning. "You mean you've accrued sufficient glory to win Pelsh."

"Exactly. The discoveries I have been a part of involving the darmats will make me the most celebrated scientist on Rehbollo." A pause. "Pelsh will make her decision soon. I can tarry here no longer."

Keith thought for a moment. "No female Waldahud has ever worked aboard *Starplex*. When my term of office ends, it will be an Ib's turn to be director; I suspect Wineglass will get the job. But after the Ib, the position will then fall to a Waldahud—and I know the Waldahudin will demand a female leader. What if—what if you and Pelsh came to *Starplex* together? From what I've heard, she'd be a natural for the director's job."

Jag's fur rippled in surprise. "We can't do that. We will both still be part of a larger grouping. She will retain her entourage until she dies."

Keith's eyes widened a bit. "You mean the males that don't succeed with her don't get to try their luck elsewhere?"

"Of course not. We will remain a family. We have all been pledged to Pelsh since childhood."

"Perhaps you could all come to serve aboard *Starplex*—all six of you."

Jag moved his lower shoulders. "*Starplex* is for the best and brightest. I would never speak to a Waldahud in disparaging terms about other members of my lady's entourage, but I will tell you the truth. It has never been a contest between me and four others. Never. It was between me and one individual. That was clear from the beginning. The others . . . lack distinction."

"But I thought Pelsh was related to the royal family. Forgive me, but why would she have less than the most-qualified suitors?"

"An entourage must continue to function even after a mate is chosen. A skillfully selected entourage will contain several members who will be content with lesser stations. Indeed, an entourage composed entirely of what you humans call alpha males would be doomed."

Keith thought about this. "Well, if the only way we can get you is to take your whole family, then I will see to it that we do so."

"I—I do not think you will follow through on that."

Keith blinked. "I'm a man of my word."

"The real contest for Pelsh was between me and one other. That other, of course, has a name." Jag's four eyes locked on Keith's two. "That name is Gawst Dalayo em-Pelsh."

"Gawst!" said Keith. "Who led the attack on *Starplex*?"

"Yes. He escaped the darmats and is now back on Rehbollo."

Keith was still for ten seconds, then began to nod. "You had to help him, didn't you?"

"I have admitted nothing," said Jag.

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"If you didn't help him, all the glory in bringing *Starplex* home to Rehbollo would have been his; he would have been chosen by Pelsh. By assisting him, you assured that the glory would be shared."

"There are 260 Waldahudin aboard *Starplex*," said Jag.

The sentence floated between them for several moments. Keith nodded, understanding. "So if you hadn't helped him, doubtless he would have found someone else who would have," said Keith.

"Again," said Jag, "I admit nothing." He was quiet for a time. "Of course, Queen Trath's government may bring criminal charges against Gawst. He soon may not have his liberty—or even his life."

"My offer still stands," said Keith.

Jag bowed his head. "I—*we*—shall consider it." And then Jag did something Keith had never seen any Waldahud do before. He added the words, "Thank you."

It was evening; the corridor lighting was dimmed. As he always did just prior to dinner, Keith dropped by the bridge, and had a word with the gamma-shift director, a Waldahud named Stelt. Everything was running smoothly, Stelt said. Not a surprise; Keith would have been called at once had something been amiss. Keith wished everyone a pleasant night and left the bridge, heading toward the central shaft.

Lianne Karendaughter was there, sitting on a bench in the widened part of the corridor just before the elevators. She looked lithe and sexy in a skin-tight black jumpsuit.

Surely a coincidence, thought Keith. Surely she didn't know his routine—know that he passed this way every evening at this time. She must be waiting for somebody else.

Lianne had her hair down; Keith had never realized that it went halfway down her back. "Hello, Keith," she said, smiling warmly.

"Hello, Lianne. Did—did you have a good day?"

"Oh, yes. I mean, you saw alpha shift today—a breeze. And I got to do some swimming and fencing during beta shift. How about you?"

"Fine. Just fine."

"That's good," said Lianne. She paused for a moment, and looked down at the rubberized flooring. When she lifted her head again, she didn't quite meet Keith's eyes. "I, ah, understand Rissa is away today."

"That's right. She's taken a pod back to Grand Central. I think she's trying to find a way not to have to accept a medal, or have a parade in her honor."

Lianne nodded. "So I was thinking," she said, after a moment, "that perhaps you'd be all alone for dinner."

Keith felt his pulse quickening. "I—I suppose I am," he said.

Lianne smiled at him. She had perfect white teeth, perfect alabaster skin, and the most beautiful dark, haunting, almond-shaped eyes. "I wondered if you'd like to join me. I've got a wok in my apartment; I could make that stir-fry I promised you."

Keith looked at . . . at the *girl*, he thought. Twenty-seven. Two decades younger than himself. He felt a slight shifting in his shorts. It was probably

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just an innocent invitation. She felt sorry for the old guy, or maybe was trying to ingratiate herself with the boss. Just some stir-fry, maybe some wine, maybe. . . .

"You know, Lianne," said Keith, "you are a very beautiful woman." He held up a hand. "I know, I'm not supposed to say things like that, but we're both off duty. You're a very beautiful woman." She lowered her eyes. He paused and chewed on his bottom lip. And a thought welled up in his brain.

Don't hurt Rissa.

You'll only hurt yourself.

"But," he said at last, "I think it's better if I just admire you from afar."

She met his eyes for a moment, then dropped them again. "Rissa is a very lucky woman," Lianne said.

"No," said Keith, "I'm a very lucky man. See you tomorrow, Lianne."

She nodded. "Good night, Keith."

He went home, made himself a sandwich, read a few chapters of an old Robertson Davies novel, then went to bed early.

And slept like a log, absolutely at peace with himself.

Alpha shift the next day started uneventfully. Rhombus had arrived precisely on time, of course; Thor came in, put his feet up on the helm console, and started dictating instructions into the navigational computer; Lianne was hard at work briefing little holographic heads of her engineers on the day's proposed work. In the back row, Keith was talking quietly to Rissa, who had just returned from Grand Central.

But then the starscape split, and Jag came in, moving with more of a run than a waddle.

"I've got it!" he said—although from the excited waving of his fur, perhaps "Eureka!" would have been a more appropriate translation.

Keith and Rissa turned to look at Jag. He didn't go to his workstation; instead, he moved to the front of the room, standing about two meters ahead of Thor's console.

"What have you got?" asked Keith, resisting the potential straight line.

"The answer!" barked Jag, excitedly. "The answer!" He caught his breath. "Bear with me for a moment; this will take some explaining. But I'll tell you one thing up front—we *do* matter! We do make a difference. Gods of the mountains, rivers, valleys, and plains—we make *all* the difference!" His eyes diverged, one falling on Lianne, a second on Rhombus, a third on Rissa, and the fourth on Thor and Keith, who were lined up one behind the other from Jag's point of view.

"We know now that time travel from the future into the past is possible," he said. "We've seen it happen with the fourth-generation stars, and with the time capsule Hek and Azmi built. But consider the implications of that. Suppose that at noon tomorrow, I used a time machine to send myself back in time to today. What would we have then?"

Keith said, "Well, there'd be two of you, right? The Jag from today, and the Jag from tomorrow."

"That's right. Now think about that: if you have two of me, you've doubled

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the mass. I mass 123 kilograms, but if there were two of me here, then there'd be 246 kilos of Jag-mass aboard this ship."

"But I thought that was impossible," said Rissa, "because of the law of conservation of mass and energy. Where did the extra 123 kilos come from?"

Jag looked triumphant. "From the future! Don't you see? Time travel is the only conceivable way to overcome that law. It's the only way to increase the total mass in the system." His fur continued to dance. "And what about the stars from the future? As each arrives, the mass of the present-day Universe is increased. After all, even fourth-generation stars are made up of pre-existing recycled subatomic particles. Pushing them back in time means that those particles have essentially been duplicated, doubling their total mass."

"An interesting side effect, no doubt," said Rhombus. "But it still doesn't explain why the stars are being sent back."

"Oh, yes it does. The doubling of mass is not just a side effect—not at all! Rather, it's the *whole point* of the operation."

"Operation?" said Keith.

"Yes! The operation to save the Universe! These stars are being pushed back in time to increase the mass of the entire Universe."

Keith felt his jaw dropping. "Good God."

All four of the Waldahud's eyes converged on Keith. "Exactly!" barked Jag. "We've known for over a century that the visible matter in the Universe accounts for less than 10 percent of the total that must be present. The rest is neutrinos and dark matter, like our giant friends outside the ship. We now know *what* all the matter in the Universe is, but we don't know *how much* there is in total. And the fate of the Universe depends on how much mass it has, on whether the total is above, below, or precisely at the so-called 'critical density.'"

"Critical density?" asked Rissa.

"That's right. The Universe is expanding—and has been ever since the Big Bang. But will that expansion go on forever? That depends on gravity. And how much gravity there is, of course, depends on how much mass there is. If there isn't enough—if the mass of the Universe is less than the critical density—gravity will never overpower the original explosion, and the Universe will continue to expand forever, all the matter in it spreading out farther and farther. Everything will grow cold and empty, with light-years separating individual atoms."

Rissa shuddered.

"And if the opposite is true—if the mass of the Universe exceeds the critical density—then gravity *will* overcome the force of the Big Bang, slowing down and eventually reversing the Universe's expansion. Everything will fall in on itself, collapsing in a 'Big Crunch' into a single block of matter. If conditions are right, that block might eventually expand again in another Big Bang, creating a new, and probably radically different, universe—but everything that had been part of this Universe would be destroyed."

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"That hardly sounds much better," said Rissa.

"True," said Jag. "But if—if!—the Universe has *precisely* the critical density of matter then, and only then, can our Universe go on in a viable state forever. The expansion caused by the Big Bang will be slowed to a virtual halt by gravitation—the expansion will asymptotically approach a zero rate. The Universe will not die a cold, empty death, and it will not collapse back in on itself. Instead, it will exist in a stable configuration for trillions upon trillions upon trillions of years. For all practical purposes, this Universe will be immortal."

"And which is it?" asked Rissa. "Is the Universe above or below the critical density?"

"Our best current estimates are that the mass in the entire Universe of all that we can see, plus the mass of all we cannot, including all dark matter, falls 5 percent short of the critical density."

"Meaning the Universe will expand forever, right?" said Lianne.

"Exactly. Everything will continue to fling away from everything else. The cosmos will die with all of creation ending up the merest fraction of a degree above absolute zero."

Rissa shook her head.

"But it doesn't have to happen," said Jag. "Not if they can pull it off."

"Not if who can pull it off?" asked Keith.

"The beings in the future—the descendants of the Commonwealth races. You said it yourself, Lansing: you are going to become vastly old, live for billions of years. In other words, immortal. Well, truly immortal beings would eventually have to deal with the death of the Universe; it's the one thing that could indeed end their lives."

"But what about entropy?" asked Lianne.

"Well, yes, the second law of thermodynamics does predict an eventual heat-death for any closed system. But the Universe may not be entirely closed; there are, after all, good theoretical reasons to believe our Universe is only one of an infinite number. It may be possible to pull in energy from another continuum, or to simply conserve energy here, producing minimal entropy, so that this continuum will be viable virtually forever. In any event, they would have untold trillions of years before that issue would have to be faced—trillions of years to come up with an answer."

"But—but—it's an inconceivable project," said Keith. "I mean, if we're currently 5 percent below the critical density, how many stars would have to be pumped back? Even one from every shortcut wouldn't be enough, would it?"

"No," said Jag. "Our best estimate is that there are four billion shortcuts in our Galaxy. Let's assume that that's typical—that they've built one shortcut for every hundred stars not just in the Milky Way, but in every galaxy in the Universe. Stars account for roughly 10 percent of the mass of the Universe; the other 90 percent is dark matter. So, if you pumped one average star through each shortcut, you'd increase the mass of the Universe by one one-thousandth of its current to-

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tal. To increase the mass by one-twentieth—which is 5 percent—you'd need to pump fifty stars through each shortcut."

"But—but surely if you have time travel, you don't need to save the Universe," said Keith. "You could live for ten billion years, then time travel back to the beginning, live another ten billion, travel back again, and so on, forever."

"Oh, indeed—and who knows how many cycles of that our descendants might go through before they work up the nerve and the technology to undertake this project? The endless time-jumping method gives a pseudo-immortality—it's clearly inferior to actually making the Universe last forever. Not only does it mean no building or other structure can have a lifespan longer than ten billion years, but it limits immortality to those beings who actually have time travel."

"I suppose," said Keith. "But what a project!"

"Indeed," said Jag. "And it might be even greater in scope than it first seems. Tell me: how old is this Universe right now?"

"Fifteen billion years," Keith said. "Earth-years, that is."

Jag moved his lower shoulders. "Actually, although that is the most commonly cited figure, no astrophysicist believes it. Fifteen is a compromise, halfway between the ages of the Universe suggested by two different lines of reasoning. The Universe is either as young as ten billion years, or as old as twenty. Since the mid-1990s, the accepted value of the Hubble constant—which measures the rate of expansion of the Universe—has been about eighty-five kilometers per second per megaparsec. That means the Universe is still flinging apart at a great rate from the original Big Bang—that gravity has done little to slow the expansion so far—and therefore it can't be much more than about ten billion years old.

"But spectral studies of extreme first-generation stars, especially those in globular clusters, suggest that such stars have been undergoing fusion for almost twice that length of time. We've long assumed that one calculation or the other must be wrong. But perhaps neither is. Perhaps what we're seeing now is merely the most recent phase of a multi-stage project. Perhaps I was premature in rejecting Magnor's suggestion earlier about pushing globular clusters through shortcuts. Perhaps such clusters, each containing tens of thousands of stars, have already been shoved back from the future. It's possible that originally this Universe contained far, far less than 95 percent of the critical density of matter, and that the current phase of the project is just some fine-tuning."

"But—but surely the mass doubling is only temporary," said Lianne. "To go back to your original example, if you traveled back from tomorrow to today, there'd be two of you today—but tomorrow, one of them would presumably disappear back into the past."

"Perhaps so," said Jag. "But for the entire span between the departure point in the future and the arrival point in the present, you *have* doubled the mass. And if those two points

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were separated by ten billion years, then you've doubled the mass for a very long time indeed—long enough for its effects to put the brakes on the Universe's expansion. If you calculate with great care, you don't need to permanently increase the mass of the Universe. You only need to do it long enough for gravitational attraction to halt the rate of expansion of the original explosion. If you do it just right, even without a permanent increase in mass, you could end up with a Universe in the far future that is indeed precisely balanced—a Universe that will live forever."

Jag paused for breath. "It's the most massive engineering project ever undertaken," he said. "But it sure beats the alternative—which was to let the Universe die." He beamed at the members of the bridge staff. *"We* did it. Regular-matter creatures—creatures with *hands!* In the end—correction, to *prevent* the end—the Universe needed us!"

The ceremony, held in their favorite Waldahud restaurant, was short. The audience was much bigger than their original family-only wedding in Madrid; any sort of celebration was welcomed aboard *Starplex*.

Thorald Magnor had been promoted to acting director for the day so that he could perform the service. "Do you, Gilbert Keith," he said, "again take Clarissa Maria, to love, honor, and cherish, in sickness and in health, for richer or poorer?"

Keith turned to face his wife. He remembered the day twenty years ago, the day they had first gone through this ritual, a wonderful, happy day. It had been a good marriage—stimulating intellectually, emotionally, and physically. And she was, if anything, more beautiful, more challenging today than then. He looked into her large brown eyes, and said, "I do." Thor turned to face her, but before he could speak, Keith squeezed his wife's hand and added, loudly, for all to hear, "For as long as we both shall live."

Rissa smiled at him radiantly.

Hell, thought Keith, twenty years was just scratching the surface. . . .

Epilogue

Keith Lansing had been sleeping well for weeks now. He lay in bed, next to his beautiful wife, drifting off to sleep. So what if he and Rissa and Jag and Longbottle and Rhombus and all the other billions of Commonwealth citizens didn't yet amount to a hill of beans in this crazy Universe? So what if they were a cosmic afterthought, an unexpected byproduct of dark-matter art? Someday they *would* make a difference—they would make *all* the difference. . . .

Keith woke with a start. He pulled back the little card covering his clock face; it was 0143. He sat up in bed and listened to the white noise PHANTOM was playing through the room's sound system.

Christ, he thought. Good Christ.

Pushing billions of stars from the future back in time would change the past—change it radically, change it chaotically. There's no way the timeline would unfold the same way as it had originally—no way this past

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would end up giving rise to the same future. You couldn't avoid a paradox—unless . . . unless. . . .

Unless you were going to come back in time yourself—back to a time *before* the first matter from the future appeared. Keith felt his heart racing. All the beings from the far future must be here already, somewhere in the present.

He recalled the pictures he'd seen of that smooth ball of metal—metal that had once been the boomerang sent from Tau Ceti to the Tejat Posterior shortcut, metal altered by fantastically advanced science.

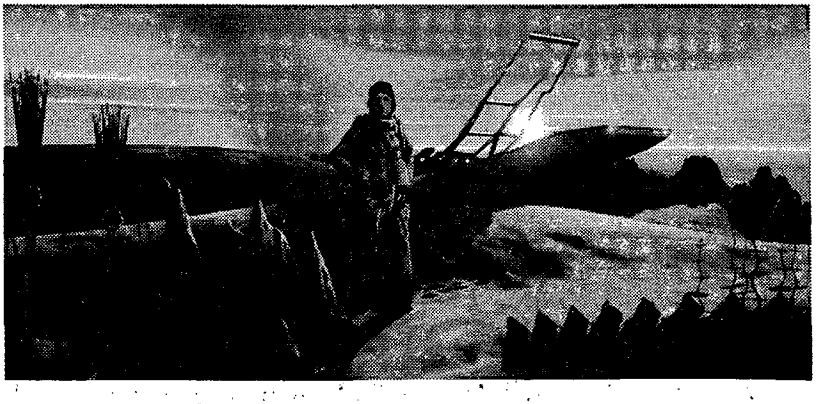
The Slammers had indeed closed the door on the Commonwealth . . . closed the door on their own past. They'd made it very clear that they wanted to—*needed to*—remain isolated from the earlier versions of themselves.

Using that shortcut—and doubtless countless others—were people from the future. And among those people would be the version of himself that had signed the message on the time capsule, the version who was apparently a leader of the project to save the Universe—a multi-billion-year-old Keith Lansing, a Keith Lansing who had become, quite literally, the grand old man of physics. How he would love to meet that other self. . . .

Keith looked at Rissa in the dim light. She was still fast asleep, but his movements in the bed had pulled the sheet off her. He gingerly replaced it, then lay back against the pillow, and slowly fell into unconsciousness, dreaming of a glass man. ■

Even though the arc of the moral Universe is long, it bends toward justice.

—Martin Luther King, Jr.



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Ian Randal Strock

THE COMING OF THE MONEY CARD: BOON OR BANE?

Since Garrett P. Serviss's *The Moon Metal* was published in 1900, science fiction has discussed changes to our monetary system. Usually background material, they occasionally emerge into the forefront of the story. Now, they're emerging into the forefront of life.

E-money (or electronic money) is no longer science fiction—Visa has started issuing what it calls "Debit Cards" through various banks. As detailed in *Popular Science*'s July 1995 article, "E-Money" is the next step in our media of exchange.

The two most probable forms are: a debit card on which your entire financial history is stored (or which accesses that history from a centralized computer system like a bank), from which purchases are deducted and to which deposits are added; or a stored-value card, akin to a pocket of cash, from which purchases are deducted, and which can be replenished or disposed of and replaced.

Visa's current debit card is basically an advanced ATM card, and even doubles as an ATM card. After paying your monthly fee, you can use the debit card as you would a credit card (and sign the same style of charge slip). The only difference is, the amount of your purchase is immediately deducted from your checking account. No more "playing the float," writing a check when the credit card bill comes in at the end of the month. On the other hand, no more late payment interest fees—you've already paid. This is the forerunner to the debit card containing your financial history.

The sudden proliferation of telephone calling cards make us familiar with the future stored-value card. You "deposit" whatever amount of money you want on the card, and then use it, as described above, as you go. When you've used it up, you can replenish it or replace it. Visa "Visa Cash" cards (to be used at the 1996 Summer Olympic Games) are stored-value cards, and seem to indicate that Visa is trying to cover all bases.

Each of these money cards has ad-

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vantages and disadvantages when compared to the other, but whichever form triumphs, the entire concept is usually discussed as a *fait-accompli*, awaiting only the determination of a standard and the installation of the necessary hardware. As *Analog*'s August 1990 editorial "Bag Limit" discussed (on a very different subject), the ultimate choice is not either one or the other, but rather one paradigm or the other: e-money or not e-money.

That is the question discussed here, from which you can draw your own conclusion. But remember, as you're thinking about it, your bank and government are at work deciding the outcome: if you form an opinion on the subject, make sure to let those making the decision for you know which way you'd prefer it made.

The Advantages

The most commonly touted advantage of money cards, of either sort, is ease of use. No longer will you need to carry around a pocket full of paper slips and metal disks: you'll need only one heavy plastic card, which you can swipe through a reader, show to a clerk, or stick in a vending machine slot, and the purchase amount will be taken from the card. Certain proposed security features would make debit cards unusable by anyone other than the owner, which would limit theft. [See "Security Measures" sidebar.]

They also make accounting much

Security Measures

Current and potential security measures include those in use today, both on credit cards and elsewhere, as well as many only imagined.

The most basic measures include signature matching, photographic identification, and PINs (Personal Identification Numbers—the code you need to use your ATM card). Other near-term security devices include various uses of encryption such as PGP either alone or in combination with multiple verification and control computer chips in the money card. [PGP (Pretty Good Privacy) is a nearly universal computer security device, in which a user disseminates one of two mathematical keys, the public key, and keeps the private key. The user signs messages with a signature encoded with the private key that can only be decrypted with the public key, proving their authenticity.]

Longer-term security possibilities include implanted voice-recognition chips or finger-print readers to verify the user's identity.

Another potential feature/flaw is a short-range transceiver. Rather than giving your money card to the store clerk, the card would be able to communicate via short-range radio or infrared signals with the store's system. While keeping the card in your possession at all times, this system may be open to tapping (as opposed to direct card-to-system contact, which can't be tapped, but wherein you give up your card for a time).

And, of course, the added security feature of a stored-value card is that, if it is lost, all that is lost is the current amount stored on it. If a debit card is lost, one's entire financial account can be wiped out.

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simpler: no more saving receipts, matching up canceled checks with records, or paying off credit cards, while trying to remember what was purchased at which store. A debit card will be able to tell you exactly when you purchased what from which store. Forget the receipt; you'll be able to get a print-out at year-end, month-end, or on request. Don't worry about adding up cryptic checks to make sure they balance without knowing what you wrote them for: you've used your debit card, and the list of purchases will be available. As for paying off the credit card company with any potential interest payments, well, you haven't used a credit card. You've used your money card—you paid for your purchases at the time you got them. No delayed billing; no interest on the short-term loan.

Everyone complains about filling out tax forms at (fiscal) year-end, and cheating on your income tax is nearly a national pastime in the USA. With debit cards, however, it will be very easy to list all credits to your account from whichever sources (and to categorize them), list all debits from the account to qualifying recipients, and then total the taxable income and figure the tax owed. Indeed, the Internal Revenue Service (or other government revenue-collecting arm) might be able to do it for you, sending you a receipt for the amount they debit from your account. No longer will those voluminous income tax forms be necessary. Think of the trees saved, and the time, frustration, and late-night drives to the post office for a postmark.

Money cards are replaceable. Prove your identity, report the loss of your card, and its identifying number will be invalidated in the entire banking system, while a new card is issued. No mess, no fuss. Cash is not so easily replaceable. (However, while a stored-value card's identification number can be invalidated, its value at the time of loss cannot be verified or replaced.)

Money cards (the non-disposable type) are environmentally sound. The average life-span of a US dollar bill is 18 months. The life-span of a money card is considerably more (current credit cards usually expire in three years, but remain physically usable far longer). The US government prints billions of dollars (3,577,600,000 one-dollar bills in 1993) and mints billions of coins (8,913,492,242 one-cent coins in 1987) each year. How many of each do you currently have in your pocket? With money cards, you'll need only one. Of course, the government would lose the seigniorage (the income from the difference between the cost of making the piece of money and its face value).

Rounding off prices (usually, to the next higher dollar or quarter amount) would no longer be necessary. Since we will not need a pocketful of change to pay 97 cents, there is no need to charge 92 cents plus tax rather than 90 cents (with New York City's 8.25% sales tax rate) to make an even dollar. Certainly, prices will continue to end in ".99" for the psychological value, but an hour's parking in midtown Manhattan need no longer cost $5.92 (plus New York City's 18.25% parking tax) simply to make a round value of $7.00.

Money laundering would become

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The Underground Economy

Money-laundering, the illegal drug trade, illegal gambling, and the black market. Each of these are major industries, and each functions solely because it is untraceable. What will happen to them with the coming of the money card?

Human nature being what it is, the people who operate in these fields will, out of necessity (and greed) find a way to continue to do business. In the near-term, that way may be simply trading US currency for that of another country (and indeed, these industries may be powerful enough to keep a small nation on a currency, rather than e-money, basis).

In the long run, assuming universal adoption of e-money (and there's no reason to think it won't be), these industries may transfer from currency-based to commodity-based. Indeed, currency is simply an artifact created to keep track of large amounts of commodities: the Phoenicians adopted currency about 2500 years ago, and the Egyptians, 2300 years ago. Barter on this scale, of course, will require either huge amounts of commodities, or hugely valuable commodities, but it is possible.

And finally, disguising a transaction electronically will probably always be an option for those who are talented enough to do it, or wealthy enough to employ their services. In the never-ending game of building a better mousetrap, those who would do away with the black market must remember that there are others who are trying to build a better mouse.

nearly impossible. Money laundering is most easily accomplished through untraceable cash transactions—transactions in which the source and destination of the money are unknown. With money reduced to solely electronic form, there is no such thing as an untraceable transaction.

Similarly, the drug trade relies almost exclusively on cash. To combat it, the US government has stopped printing and circulating bills more valuable than $100, to questionable effect. However, stopping the circulation of all paper money would force every transaction to be recorded, and such large value transactions would be glaringly obvious to the most rudimentary of search programs.

Illegal gambling, the sometime twin of the drug trade, and definitely part of money laundering, would also need to find a new medium of exchange if it were to survive. [See "The Underground Economy" sidebar.]

The Disadvantages

Privacy will disappear. In a system where every transaction is recorded, the government, or an unscrupulous employer or neighbor, can know your every transaction. "Did you know Joe bought a copy of a skin magazine yesterday?" "Jane is cheating on her diet—she bought three candy bars last week." Minor annoyances. But what about the high schooler's purchase of condoms? Embarrassing, but far safer than not buying them. Will he do so if his parents can track the purchase? What about buying a copy of a subversive magazine? Or that rifle you'd prefer to keep in the house for self-defense? None of it will be hidden from prying eyes. Government regulation will encroach on many more as

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Privacy

Perhaps one of the greatest fears of e-money is the loss of privacy. Handing a clerk a $5 bill and walking out with your purchase provides nearly the ultimate privacy—the clerk knows nothing about you, and soon enough, the $5 bill will be circulated even further, making it almost untraceable.

One of the features of e-money is its direct link to your personal account. For a debit card to work, it must know who you are and where your money is stored, in order to tell the clerk's system where to go to get the $5.

Now the clerk (or whoever accesses the clerk's information) knows precisely who you are, and how to find a great deal more information about you. And your bank (or whoever accesses the bank's information) knows how much money you spent where.

At present, a great deal of information is collected and stored in databases near and far. Most of it is tied to a number, such as (in the US) your social security number. With access to any database, nearly all the others can be found and put together to form a fairly complete picture of you.

What isn't there, however, are transactions and actions that are not recorded. There is no record of the newspaper or magazine you bought as you ran to catch the train. There is no record of the lunch you bought from a sidewalk vendor. There is no record of the movie you saw after you gave the theater cash. And there is no record of your cash donation to the Communist Party or the John Birch Society.

With money cards, however, ALL of those transactions were recorded, and are there for you, and anyone else, to see. "The right of the people to be secure in their persons, houses, papers, and effects, against unreasonable searches and seizures . . ." [US Constitution, IV] becomes a much less meaningful amendment, when the police can simply access the bank's records, and know that you've purchased an unregistered handgun, or a subversive magazine, or a birth-control device.

A potential solution to this problem involves multiple computer chips in your money card, as well as multiple encryption and decryption steps, which may allow transactions to be unrecorded. However, in order for electronic transactions to work, one side must be able to record it in order to debit the money, and the other must be able to prove that the added money is really there—that it came from somewhere.

A stored-value card would afford slightly more privacy, since the cards need not be "smart." Rather, a stored-value card only needs to know how much money it is worth, and how much it is giving away. However, in order for privacy to be maintained, certain security features would have to be disabled (if you have to prove your identity to use the card, the privacy feature disappears).

This may be a case where the black market, the illegal drug trade, or illegal gambling will lead the way. People participating in these fields, as we've often seen in science fiction, require privacy, and frequently anonymity, in order to function. They have the greatest incentive to find workable privacy measures, and may lead the fight against governmental intrusion.

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pects of private life because it can. [See "Privacy" sidebar.]

Your ability to negotiate will be diminished. Buying a new house? Well, if the seller's agent can read all of your financial records, you won't be able to plead poverty to knock the price down a bit. The used car salesman will know to the cent how much you've got in your account and what you can spend on his lot.

If the power fails, or the money card transaction system crashes, you won't be able to buy anything. Today, if the power fails or the credit card system (actually, a telephone connected to a computer) fails, you can hand the clerk cash and walk out of the store with the container of milk for the baby. But with a money card, if the phone lines go down, or your bank's computer takes a sudden vacation, you're broke, no matter how much money you've got. The extreme version of a power failure, a nuclear detonation (admittedly, these seem less probable today than a few years ago) would cause an EMP (electromagnetic pulse) which, in addition to shorting out all the electronics in your computer and car, would also erase your financial history, accounts, and money. No cash under the mattress, in a cashless society, means no money at all.

A major disadvantage is to monetary gifts: no longer will the tooth fairy be able to place a quarter (or is it now a dollar?) under a child's pillow. Forget the ten-dollar bill or check in the birthday card, the 18-dollar check[1] in the Bar Mitzvah card, or the "nice little something" for the newlyweds.

Tipping will see massive changes. Rather than leaving a few dollars on the table in a restaurant, patrons will include a gratuity on their money-card-paid bill, and the restaurant will then have to reimburse the waiter. [Currently, some restaurants reimburse servers their credit card tips from the day's receipts, and then take the credit card tip when it arrives from the bank. Others require the staff to wait for the payment, and then include it on the paycheck.] Tips, which are taxable income in the US, will be faithfully reported. Tipping for other services will be even more difficult. The taxi's fare machine will take your money card, but will the taxi service reimburse the driver? And how will you tip the person at the airport or hotel who carries your luggage?

Charity and handouts of money will all but disappear. It's very easy to throw some money into the collection plate at church, or slip the coins from your change into the can at the cash register. It feels good to hand your pocketful of change to someone who needs it. These all work because they're quick and simple—you don't have to think about donating money to charity. But when it's a transaction which requires your money card, well, that's a different story.

The cost of installing all those card readers will be high, and of course borne by the consumer (what, the store would not pass the cost along in higher prices?). At first, of course,

1. The Hebrew word for "life," is spelled with the eight and tenth letters of the Hebrew alphabet.

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only the largest companies will be able to afford the technology, but as prices drop, and it becomes clear that everyone is using a money card, smaller businesses will install them, too. Will the cost ever drop far enough for everyone to have a credit transfer machine? Or will individuals no longer be able to receive money from other individuals? Will only your employer and the government be able to add money to your account?

It will be much easier to raise prices. Handing a clerk your money card feels precisely the same, whether your account is being debited $5.00 or $50,000.00: counting it out in physical money, however, lets you know you're paying a different price. If prices at the supermarket didn't all end in 9, would you know if the price of this or that item had gone up two cents in the last week? Well, your money card makes paying any amount as quick and easy as paying any other amount, so does it matter if prices rise two cents a week?

Short-term, small loans will disappear. What loans? Those you get when you buy something with a credit card. Can't afford a $4,000 computer this month? Well, you can buy it and take it home today, and pay the credit card company $500 a month for the next nine months. With the advent of the money card, however, the credit card may disappear, along with that short-term $3,500 loan. Why should banks bother to take the risk of a bad credit-card loan?

Paying for a drink at the bar will be more than simply leaving a few bills on the counter. And will the money card tell you when you've had enough, by refusing to purchase any more?

Does it Have any Other Potential Effects?

Mail-order businesses, which rely on checks and credit cards, will have difficulty. Most planned security measures for money cards would make them unusable except in face-to-face transactions. [See "Security Measures" sidebar.] However, telephone transactions may continue nearly unaffected: portable modems, akin to present-day pocket dialers, will allow money cards to interact with computers over telephone lines.

The less emotional feel there is to a thing, the less incentive there is to protect/save it. So too with money. Cash in your pocket elicits a specific feel. Small children understand the desire to conserve it and watch it grow: we teach them how to handle money with the tokens we currently use. With a money card and no cash, however, that desire will disappear, and the emotional need to save (as opposed to the intellectual) will diminish.

Barter will again become popular, as people who wish to transact business without records and without giving a piece to the government, return to this moneyless medium of exchange. Barter simplifies the economy by keeping the number of transactions down, but it is cumbersome for other than simple one-to-one trades. [See "Privacy" sidebar.]

The black market will disappear—or will it? All transactions will be recorded, and you'll need to have an account on the system to receive mon-

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ey, so the black market, which relies on not being traced or recorded, will cease to exist—unless it finds another way to operate. The black market is usually considered an evil, but numerous stories have shown science fiction readers its usefulness. [See "The Underground Economy" sidebar.]

If the change to money cards is not universal, some other currency will become the world standard. This may or may not affect the average person, but it will probably cause the US dollar's value to drop, as it will no longer be perceived as so "strong" (valuable) in other countries.

Money will cease to have any meaning. It will be nothing more than a form of keeping score. (Although some may argue that money never was anything more than a score-keeping tool.)

What About the Rest of My Life?

Vast areas of life, including transactions, will be nearly unaffected by the coming of the money card. Running a money card through a turnstile will be the same as using your transit pass. Paying for a purchase with a money card will be identical to using a credit card (except that no bill will show up next month). Replenishing your supply of ready money (with stored-value cards) will be the same as taking cash out of a bank machine.

None of your life will be unrecognizable, though a totalitarian government would find wondrous new abilities in a money card society. The requirement, therefore, is caution. Or, as Thomas Jefferson put it, eternal vigilance.

So What do I do About It?

That depends. Do you think these changes will be good for you, and increase your enjoyment of life? Then tell your bank, tell your governmental representatives, and tell your friends, that you want a money card. Also tell them whether you prefer the kind with all your finances on one card, or the stored-value card, or perhaps a system where both are available.

If you don't like the sound of these changes, tell your bank and your government and your friends. Tell them why. And be prepared to form an underground economy, because most indications show that the money cards are coming. Others, like Visa, say that they're already here. ■

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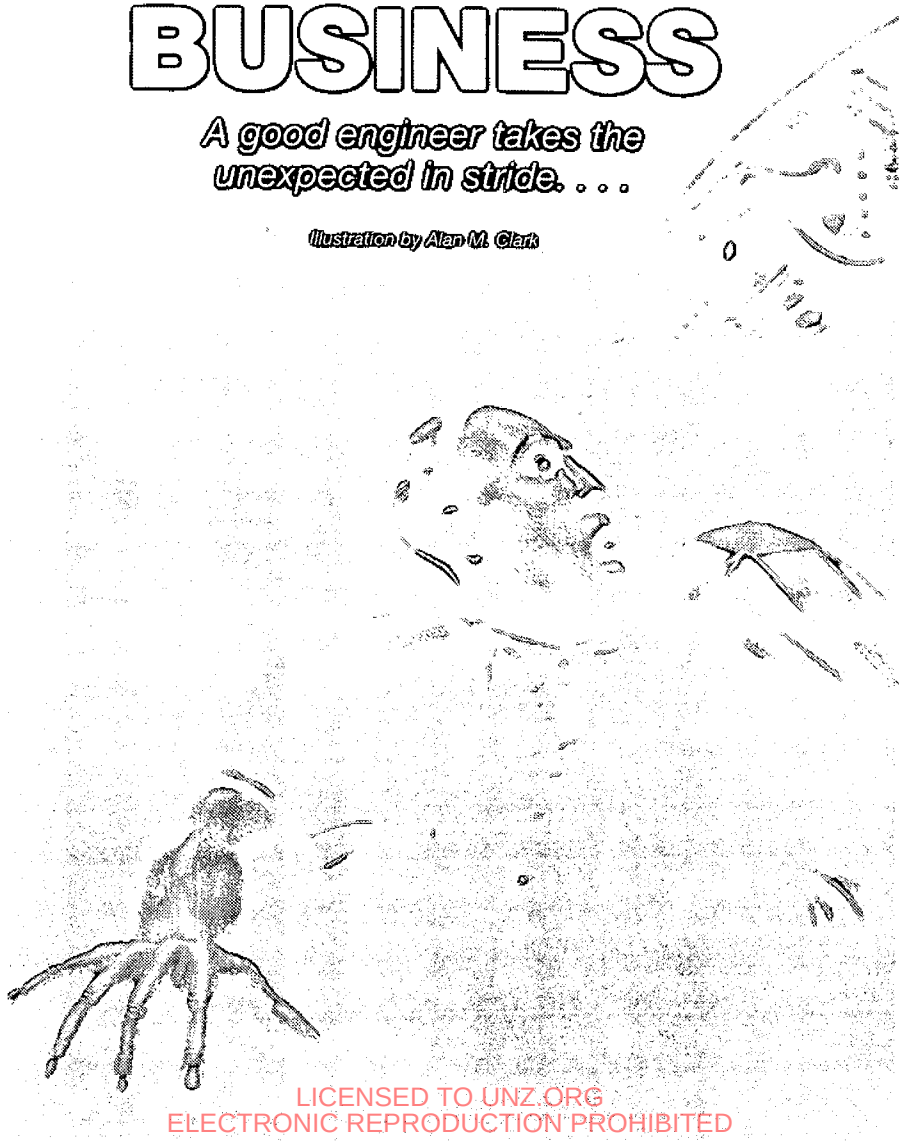
Jerry Oltion

UNFINISHED BUSINESS

A good engineer takes the unexpected in stride. . . .

Illustration by Alan M. Clark



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The first time I met Tilbey, he made my blood boil. He apologized profusely while he dragged me back into the ship—he'd been working on the forward airlock and apparently got his wires crossed—but I hardly heard him. The roar of air whistling away through the open doors drowned him out.

I was a last-minute hire on the Earth-Mars cargo transport *Intrepid,* replacing a crewmember who had quit just before launch. I had considered myself lucky to get the job, at least until now. Now, with my vision going swirly and my skin tight as a balloon, I considered myself as good as dead. But Tilbey proved to be as resourceful as he was clumsy; he dumped me in one of the control room's two acceleration couches (banging my head painfully against the armrest, but hey, what's a minor injury when you're dying?), then he jumped back into the airlock, shorted out a couple of wires dangling from the mid-lock control panel where he'd been working, and the outer door slammed shut—catching Tilbey's tether rope in the jamb and pinning him in place.

The tether wouldn't budge, so Tilbey unhooked it from his spacesuit's belt to give himself more freedom, but that still didn't solve our problem. The airlock couldn't seal completely with the tether in the way. Though the pressure had gone back up, I could still hear the ominous hiss of breathing air venting into space. Tilbey eyed the situation for a moment, then closed the inner door. Through its tiny window I could see the outer door open again, and I caught a glimpse of an arm flailing as Tilbey tripped on something.

It seemed to be taking an awfully long time for him to coil up his tether and come back in. I waited a couple of minutes, gasping like a fish the whole time, but when he still hadn't showed I pushed myself toward the door. The tiny control cabin was a blizzard of papers and coffee bulbs and all the other debris that had been blown free during the decompression, so I had to bat stuff aside to see through the window, but when I looked out I saw Tilbey's tether drifting like a lazy snake, its head still attached to the D-ring beside the airlock. The other end attached to nothing. Tilbey had forgotten to reconnect it, and now he was nowhere to be seen.

We picked him up, of course. He hadn't drifted far, and we had plenty of maneuvering fuel, so it was no big deal. It seemed the crew of the *Intrepid*—three others besides Tilbey and myself—were used to things like this. At dinner that night they laughed and told stories about the other silly things Tilbey had done, and they toasted me as an official, Tilbey-ized member of the crew. Even Captain Hoxworth, his unkempt gray hair and bushy eyebrows giving him what I thought of as a windswept, Ulysses sort of look, laughed and said, "Welcome aboard, Mister Danbury. I had hoped to preserve your innocence for a bit longer than your first watch, but now you know the truth: the *Intrepid* is a jinxed ship."

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Throughout it all, Tilbey's round, cherubic face carried a pained expression, but at the captain's pronouncement he screwed it into a true grimace and said, "Look, I said I was sorry."

Everyone laughed, me included, even though my lungs still felt like they were pumping salsa fumes instead of air. Gwen slapped me on the back when I started coughing, and Peter passed me a bulb of vodka "to dull the pain." He handed Tilbey one, too, and I accepted Tilbey's apology and we toasted one another's health. It seemed like the polite thing to do; after all, we would be stuck together on the ship for two months.

I wondered why the captain kept him on if he was such a klutz, but I slowly came to understand. The *Intrepid* was the worst collection of out-dated and mismatched parts to ever call itself a ship. The airlocks functioned perfectly compared to the rest of it. Hardly a day went by when some crucial subsystem didn't break down, and despite his handicap—or perhaps because of it—Tilbey was a master at repairing things.

He caused nearly as many disasters as he averted, though. And he was a slob when it came to putting things away. Even his tools, which a good mechanic usually keeps lined up neatly in his belt, were scattered all over the ship, wherever he had last used them. I would find wrenches floating in the rec room, just waiting to bean the first person through the door, or test equipment wedged into an open power box, leads still connected. Once I found a laser welder bouncing gently around the personal hygiene station, just waiting for a stray water droplet to short it out and discharge its beam into the mirror.

And his quarters were even worse. He was working on some sort of hobby project in there, had been for a couple of years, Gwen told me when I asked, but he had refused to explain what it was. All any of us knew about it was what we could see: a rat's nest of electrical components, servos, linkages, and blinking red lights.

I asked the captain if he was sure it was safe to let him build an unknown gadget, but he merely shrugged and said absently, "Tilbey knows what he's doing." We were in the control room together, and he was looking at one of the diagnostic monitors, frowning at the readout that scrolled across the screen. "At least I hope he does," he muttered. He flipped on the intercom. "Tilbey?"

"Yes?" came Tilbey's voice. The indicator said he was in his quarters.

"Can you have a look at the main engine ignitor? I can't get it to come on-line."

"I'll get right on it." There came a clatter as Tilbey crashed into something, and I winced as I imagined his project blowing up and taking the whole ship with it, but nothing happened.

All the same, the next time I saw Tilbey, he was dead. He'd finally bumped the wrong thing at the wrong time—in this case the fuel injector assembly right after he'd re-

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paired the ignitor, which he had of course left activated. He'd been working right inside the bell-shaped nozzle of the engine, and even though it had merely hiccoughed there still hadn't been enough left of him to send home for a funeral. So the captain and Gwen and Peter and I had just held a short ceremony in the rec room, then spaced one of his rumpled coveralls as a symbolic gesture. Things were considerably more sedate—but also more relaxed—after that.

Until the evening when I was standing watch in the control room again and his ghost drifted in through the aft bulkhead.

I didn't know what it was at first. I noticed the lights flicker, and the main power bus alarm buzzed for a second before it decided nothing was wrong after all and shut itself off again, but when I leaned back into the command chair I noticed a patch of white fog at the edge of my field of vision. When I turned to look directly at it it seemed to dim, the way a star in the night sky grows dimmer when you stare at it, so I looked a little to the side and saw that the apparition was shaped like Tilbey. His round cheeks and lips moved as he tried to speak, but no sound came out.

The control room suddenly felt about twenty degrees colder, and my spine felt colder still. "Tilbey?" I asked, my pounding heart making my voice quaver.

The ghost tried again to speak, but his vocal cords only made a whispery, rustling sound. He drifted closer to me, and I leaned back, and when he reached out for me I practically exploded out of the couch trying to get away.

He had evidently been reaching for support, because he made a lunge for the chair, but his hand passed right through it and he drifted into the control console. He went into it all the way up to his hips, like a swimmer walking into the water, before he came to a stop.

Warning lights wailed and alarms blinked from a dozen different circuits, but they were all short-lived. The bright flash of a short circuit lit up the control room, and suddenly we were under thrust.

It wasn't much; a fully loaded cargo ship can't do more than half a gravity or so, but it was enough to slam me to the floor and drop a half-full coffee bulb on my head. Tilbey dropped just as fast as the coffee and I did, but he didn't stop. Wearing an expression of terrified surprise, he slid through the console and the floor beneath it as if it weren't even there, and kept right on going.

The control panel tracked his path through the ship, short circuits triggering alarms in the crew's quarters, the equipment bay directly beneath it, and the starboard maneuvering thruster quad below that. Tilbey's ghost had apparently fallen all the way through the ship and right out into space again.

I scrambled up and slapped the abort switch. The sudden loss of thrust sent me rebounding up to the ceiling, where I hit my head hard enough to raise a knot. A memento of the dear departed Tilbey, as it were.

* * *

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"He must have left something undone," Peter said when I finally convinced him and the rest of the crew what had happened. "That's why ghosts appear—to finish something they left undone."

"Tilbey?" Gwen asked incredulously. "He'd be spending all of eternity at it if he had to do that."

The captain rubbed his bushy eyebrows. "Hmm," he said, as if having a ghost on board was just another in a long list of problems. "Much as I liked the poor bugger, I don't think I'd take to having his ghost roaming the ship. I wonder if we can figure out what he's up to and help him accomplish it. Then we can all rest in peace, eh?"

That was easier said than done. We didn't see Tilbey again for nearly a week. I suppose it took him that long to catch up with us, though I can't imagine what he used for propulsion. Magnetic attraction, perhaps. At any rate, we hadn't found out what he'd left undone, either, because there were so many candidates to choose from. Without Tilbey's admittedly clumsy hands holding it together, the ship was falling apart around us faster than we could keep up with it. The life support system had quit listening to its oxygen sensors, so it kept raising the partial pressure until we were breathing practically pure O_2. Trouble was, at normal pressure that made practically every flammable item on board a potential bomb, as we learned when the coffee urn switched on one morning and rocked the entire galley with the explosion. We managed to contain the fire to the galley by donning p-suits and venting the entire ship to space, but the decompression played hell with the hygiene stations, and we were about out of suit air before we could get the lifesystem back on line again. By then the water tanks had boiled dry, so we were on emergency rations, and the navigation computer had overheated without its cooling air and was now convinced we were headed for Jupiter. And if that wasn't bad enough, Mars was beginning to swell in the aft viewports. We knew we were supposed to start our deceleration burn to drop into orbit sometime within the next few hours, but without the navcom we didn't know when. And a minute's delay could mean the difference between a successful flight and a headlong crash.

So when Tilbey's ghost floated through the control room wall again, I looked up from the diagnostic program I was running on the navcom and said, "All right! Grab a seat and have a go at this mother."

Of course he couldn't grab anything. It was all he could do to bring himself to a stop before he drifted into the control panel again. He managed that by drifting through *me* instead, which felt like I'd been hit by lightning, but when I'd flinched clear of him he now floated stationary in the air before me.

He was trying to say something, but like before all he could make was a faint rustling sound. I tried to read his lips, but when I looked directly at him he was fainter than fog on a window. He tried pantomime, but I couldn't guess what he was getting at. Maybe the ship was about to blow up or

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maybe he just wanted a doughnut; I couldn't tell.

I called the others up to the control room and after they got over the shock of seeing Tilbey this way they all gave it a try, but we were no wiser until Tilbey, in mounting exasperation, started sticking his fingers through the navcom's keyboard. Every time he did, the key he pressed shorted out, which is what keys on keyboards normally do when you press them, so within a minute or so the navcom was back on line again.

We all waited breathlessly for Tilbey to vanish now that he'd repaired it, but he stubbornly remained before us, his arms crossed over his chest.

"That wasn't it," Peter said.

Tilbey waved at the keyboard again, then pantomimed speaking and words flying out of his mouth, and eventually I got it. "He can talk to us through the keyboard," I said. Trouble was, none of the control instruments were set up for word processing. I solved that by getting out my portable notepad and unfolding that for him.

He pecked away at the keys for a moment, careful not to stick his fingers too far through and short out the main processor. When he finished he drifted back and we all leaned close to see what he'd typed.

mainn drives ignitter damagged. wont lite.

The captain frowned and turned to the control board. "The sensors show it's fine," he said. "Besides, it lit OK the . . . uh . . . the last time you were here."

thats when it brroke. sensrs burnd out tooo.

There was one easy way to check that. The captain tapped in a command for a half-second burn, just enough to check the system dynamically without changing our course much.

Nothing happened.

"Figures," Gwen said. "So what do we do? We've only got—" she looked at the navcom's screen, which was showing the correct figures now "—forty-five minutes before our deceleration burn."

"I guess we fix it," the captain said. "What else?"

After Tilbey, I was the next-best-qualified drive engineer, so fifteen minutes later I found myself suited up and floating in the immense bell-shaped combustion chamber, looking at the mangled remains of the engine's ignition system. When the engine had fired with Tilbey inside, he had still been working on it, and the flameproof access hatch had been open, allowing the white-hot combustion gasses into the ignitor coils. The burst of flame that had killed Tilbey had no doubt caused some damage to them as well, but what had really done them in was the sustained burn when he had shorted out the controls a few days later. The coils were a melted mess, like we would be in a couple hours when we hit Mars's atmosphere at interplanetary velocity, because there was no fixing the ignitor. The engine itself looked fine, but with no way to get it lit we were as good as dead.

Tilbey had swum his way back through the ship, careful to avoid any

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electronics this time. Being Tilbey, he had still blown out the main lighting circuit in the cargo hold, but that was minor compared to the trouble we faced. Now he floated beside me in the engine bell, shaking his spectral head at the mess he'd made of the ignitor.

"We'll have to rig some kind of temporary system," I said. "A one-shot spark generator on a timer or something." It sounded easy enough, but I didn't know if it would be possible to do in the short time we had remaining to us. Tilbey could probably do it, but even with him coaching me I wasn't sure if *I* could.

Tilbey gestured impatiently for my notepad.

can't hear you, he typed when I unfolded the keyboard and held it out for him.

We were in vacuum, so I supposed that made sense, but since he apparently didn't need to breathe anymore I hadn't been sure about air for hearing. I wasn't sure about much where Tilbey was concerned. There were so many things I wanted to ask him, including the Big Question, but if we couldn't come up with some way to light the engine I'd know the answer to that first hand in about twenty minutes. So I typed, *We needd to majke a spark generattor on a timer.* In my p-suit, I was as bad a typist as Tilbey.

no time, he typed. *would taake hours.*

What, then? I asked.

let me do it. i can short thingss out—give mee a battery and a stopwatch and i'll make plenty of sparrk for you.

I supposed he could at that. And one spark was all we needed; once the engine was lit, the reaction was self-sustaining. But could Tilbey face the same blast of flame that had already killed him once? It seemed more than anyone had a right to ask, even of a ghost.

You'll be blown aaway from the shjip, probably forever, I typed.

He shrugged. *i'll probly juzt disappear anywayy. besiddes, i alwayss wanted to go oout in a blasze of glory.*

Well, you'll certainly do that, I typed. *You're sure about this?*

what otherr choice? i'll fall freee if you gett the drive lit annyway.

That was true enough. So I left Tilbey with my notepad, which had its own stopwatch built in and plenty of battery power to make a great spark when he passed his hands all the way through it. I wanted to slap him on the back or shake his hand or something, but all I could do was type, *Thanks, Tilbey,* on the notepad before I turned to leave him in the engine.

He waved his hand in front of my face, then typed one final message: *close the hatch.*

Right. The ignitor coil access hatch. If I'd left that open, the drive flame would have burned through and destroyed the rest of the engine within the first few seconds of thrust. I looked at Tilbey, amazed that he'd remembered, and equally amazed that I'd forgotten. He shrugged. It happens, he seemed to be saying, though he didn't bother to type it out.

I closed the hatch and left Tilbey there in the engine nozzle, climbed

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back inside the ship, and waited nervously for the deceleration burn. If it didn't work....

But it did. Tilbey did his final job without a hitch, as far as we could tell. The drive lit right on time, and the *Intrepid* shuddered its way into Mars orbit on schedule, where Captain Hoxworth demanded a complete overhaul before he or anyone else in the crew would fly it again.

And that would have been that, except for one thing I found while I was going through Tilbey's personal effects to send to his next of kin. It might take him a while to catch up with us, but I can't shake the feeling that we haven't seen the last of him. I hope we haven't. After all, he left his mystery project running in his quarters, and try as I might, I can't find a switch to shut it off. ■

IN TIMES TO COME

Back in January 1992, we had a "State of the Art" piece by Greg Barr about a unique nonprofit educational organization called CONTACT. For several years, CONTACT conferences have brought together scientists, writers, and artists to create imaginary worlds and explore plausible human-alien contact scenarios. Their most ambitious project yet is Epona, a world three years in the making, now visualized in extraordinarily rich and consistent detail and providing the stage for stories and art by several of the highly creative minds who built it—including several components of *Analog*'s November issue.

The lead novella is "Fugue on a Sunken Continent," by G. David Nordley. Nordley has already established himself as an *Analog* favorite with several stories of his own vividly imagined worlds, such as Trimus; but in "Fugue" he draws on a background even deeper than a single writer would often have the luxury of creating. Two companion pieces represent a most remarkable debut by one of the other Eponan collaborators: Wolf Read supplies both the cover and a profusely illustrated "fact article" about how Epona evolved and how it fits together. After some deliberation we decided to call it a "Special Feature" since the planet and ecosystem it describes are fictitious—but they're also an excellent demonstration of how real science can be applied to create a believable fictional world!

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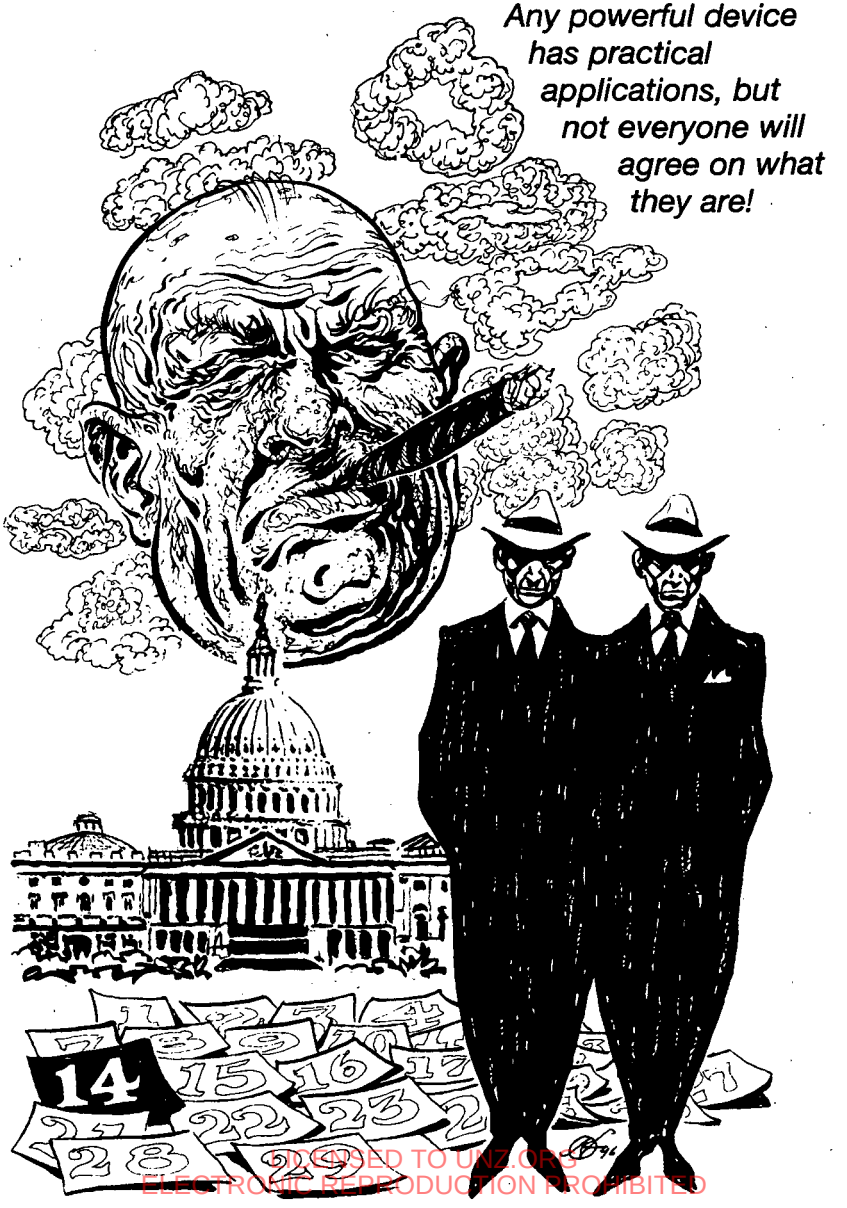
Rick Shelley

STATE OF THE UNION

Illustration by Kelly Freas



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The Senate hearing room was packed with reporters. It was a slow news day. Even the prospect of listening to a mad scientist testify before the organized crime committee was welcome.

At the moment, only one member of that committee was missing from the chamber. Since the missing man was Josiah Hitch, the ranking minority member, the session had not yet been formally opened even though everyone else had been in place for twenty minutes. There was a noisy buzz in the room as reporters talked about whatever they had to talk about. At the witness table, a single man, obviously still on the sunny side of forty, sat waiting patiently. Part of the twitter among the reporters was because the witness had come in without even one attorney. In Washington, that was news almost on the level of *Man Bites Dog*.

Josiah Hitch eventually arrived, scowling as always, and muttered pro forma apologies for being "unavoidably detained." Both the scowl and the apology were garbled by the Churchill cigar in his mouth. His colleagues were too polite to snicker. Everyone knew what had detained Hitch, what always detained him. He spent so much time in men's rooms that his less sympathetic colleagues had started talking about "going to the hitch."

Chairman Robert Tavish banged the gavel. As soon as the daily formula was complete, Tavish introduced the witness and Dr. William G. Wilson, Jr. was sworn in.

"Mister Chairman," Hitch interrupted. "Before we go any farther, I would like to make a statement." He used his cigar as if it were a conductor's baton, gesturing wildly with it, making certain that thick clouds of smoke were generously distributed. During the previous Congress, while the Republicans were still in control of both houses, the ban on smoking had been lifted. Hitch had ignored it even while it was in effect. He represented a tobacco state. Vigorously.

Tavish quickly suppressed the instinctive frown and nodded. "The chair recognizes the deputy chair."

"In all my many years in public life, I have never, *never,* seen such an incredible and unconscionable waste of time and taxpayers' money," Hitch said, fixing Dr. Wilson with his most malevolent stare and poking his cigar toward the witness table. Wilson had no business sitting there looking so smug and handsome and young. "That is quite a statement, since we all know that this body has witnessed some extraordinary wastes of both." He paused to make sure that the reporters were at least making a pretense of listening to him. He saw red lights on three video cameras. That was enough to let him continue. "Dr. Wilson, you have the temerity, the absolute *gall,* to come before this august body and claim that you have singlehandedly wiped out major organized crime in this country?"

Wilson's smile showed more than confidence. It was the smugness of a man who knew without checking that his fly was securely zipped and all was well with the world. The smile was the result of his best efforts at

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moderation. Left to his natural inclinations, he would have laughed his head off. He was not the least bit nervous about this hearing, or the ranking minority senator.

"Not exactly, Senator," Wilson said. "I did not, personally, wipe out all of major organized crime in this country. But,"—he continued when he saw that Hitch was about to launch another oration—"I *am* responsible for it being wiped out. I created the mechanism and made it possible."

"I fail to see the distinction," Hitch said.

"I came here to explain that," Wilson pointed out. "The committee has already seen much of my data. That was the reason for the hasty scheduling of these hearings, despite the fact that some individuals obviously feel that I am unhinged."

Chairman Tavish cleared his throat. "That is true—I mean, that these hearings were scheduled so quickly because of the data we have seen, and because of the obvious evidence that major organized crime does seem to have virtually disappeared over the past few weeks. And I fear that this is getting beyond simply making a statement." He glanced at Hitch. Hitch's scowl deepened. There was more he wanted to say, about the idiocy of wasting time with this witness's claim that he had invented a *time machine*, but the ranking Republican member of the committee nodded his acceptance of the chair's observation.

"Dr. Wilson, I believe you have an opening statement to read?" Tavish said, turning his attention to the witness.

"I do, sir," Wilson said.

"Go ahead, Doctor."

"Thank you." Wilson positioned the text of his statement directly in front of him, and started to read.

"My name is William G. Wilson, Jr. I have dual doctorates, in physics and mathematics. I am currently a tenured member of the physics faculty of the University of Chicago." Wilson spent just a few minutes establishing his professional *bona fides,* then looked up from his text.

"Mister Chairman, this next bit is not in the prepared statement I submitted to you, but I can't help but interject it, with your permission."

Tavish nodded, mostly because he hoped that whatever Wilson had to say would annoy Hitch more than it would him.

"Over the past several decades," Wilson said, letting his gaze travel along the arc of faces behind the raised bench at the head of the room, "it has become increasingly difficult for scientists to obtain proper funding for any research, even the most pressing and—potentially—most rewarding. Success in scientific research has become more a function of a researcher's ability to raise funds than his scientific acumen. That has been particularly true since the midterm elections in '94." Wilson paused. There was considerably more he wanted to say, but there would be time, later, for the rest. Deeds were ever so much more impressive than words.

"We have to be open-minded about obtaining research grants. A scientist who wants to stay in business has to

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be willing to accept offers, even if there are disagreeable strings tied to the money." He hesitated again, thinking that there had often been disagreeable strings attached even back when the money had come primarily from congress. Then he looked to the committee chairman and said, "I'll return to my prepared statement now."

The primary thrust of my research has always been time. On a theoretical level, that needs no more than computer, paper and pencils, and a brain. I have, of course, made use of whatever experimental data others have managed to collect, measuring the differing passage of time at different distances from the center of Earth, and at different velocities, and so forth, using those data for my calculations.

Four years ago I published a paper which suggested, among other things, that it might be feasible to build a working time machine—given rather liberal funding. I was unable to obtain that funding through any of the usual channels. Those people responsible for judging the merits of such requests saw the words "Time Machine" and immediately freaked out without bothering to properly evaluate the proposal or submit it to peer review. It was impossible, it was impractical, and anyhow, there were all of those nasty paradoxes we've been reading about since H.G. Wells.

It wasn't long before the department chair suggested that, tenure or not, it might be wise if I quit giving the university such a black eye. Research funding for my colleagues might be adversely affected if people thought that there was a certifiable lunatic on the faculty. I had little choice, actually. I continued my theoretical work, but decided that unless I won a very large lottery prize, I would never get the chance to see if my device could actually be built.

Then, just over three years ago, a week before fall semester finals, two visitors came to my office at the university, and arrived just at the end of my scheduled office hour, when I was always available for any students who want to come in and talk.

These two were obviously not students, even though it isn't unusual to find people in their thirties attending school. They were simply dressed too well. One wore a knee-length leather coat. The other's coat was genuine camel hair. The suits they wore underneath were likewise expensive and tailored, the sort a professor can't hope to afford unless he pens a best-seller.

There was nothing particularly distinctive about either man except for their clothing. I detected no accents or anything like that. They were quiet. They were polite. They sounded well-educated.

"Dr. Wilson," the man wearing camel hair said, "we would like to talk with you for a few minutes if you have the time."

I allowed that I had a little time available and asked both men to sit. With three of us and winter coats, the office was rather crowded. They took off the coats and sat.

Camel hair introduced himself as Frank Zarelli and his companion as

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Carl Pastor. Zarelli also introduced himself as an attorney. It wasn't until somewhat later that I learned that Pastor was a CPA.

"What can I do for you?" I asked.

"I think, perhaps, it's more what we can do for each other," Zarelli said. "You wrote a paper last year suggesting that it might be possible to build a working time machine." I nodded.

"Since that time, you have been totally unable to get any research funds to actually build that machine." I nodded again.

"I represent a group of . . . clients who might be willing to fund that experiment," Zarelli said.

A nod simply wasn't enough this time. I leaned forward. At the possibility of funds I came close to salivating—a Pavlovian response that any academic would recognize. "That would be welcome," I said.

"Just how much money would you require?" the other man, Pastor, asked.

I made a vague gesture. "I couldn't possibly give you a figure that would have any pretense of being accurate. Assuming a best-case scenario, I think we would be talking a minimum of eight to ten million dollars to design, construct, and adequately test a small model—a proof-of-concept apparatus. Assuming that the model were successful, it might take three times as much to construct a full-scale machine and conduct an adequate regime of testing." I smiled. "Of course, once I can demonstrate that the machine works and is practical, additional funding would be relatively easy to obtain."

Pastor nodded, very slightly. His eyes never left mine, and I realized that I hadn't seen him blink once. "You said those figures were minimums. What do you think the maximums might be?"

I couldn't restrain a small laugh. "There's no way to be certain. If we can keep the government out, perhaps no more than double the minimums. But—no guarantees."

"I think we can guarantee that the government would not become involved," Zarelli said. He and Pastor exchanged looks. Then they both looked at me again.

"I believe that it might be possible," Zarelli said. "At least through your proof-of-concept model. If that is successful, the funding would be extended through to completion. You understand, there would be certain . . . conditions."

"*If* those conditions are acceptable," I said. "I'll have to know what they are in advance."

"My clients will provide you with trained research assistants. You will provide us with lists, blueprints, or schematics of whatever you need in the way of equipment and supplies, and we will obtain them for you. We will provide a place for you to do your work, and take care of anything else you need. A representative of our principals will be on hand to act as your liaison throughout the project."

"Those conditions don't sound too onerous," I said. True, I would have preferred to choose my own assistants and so forth, but I know all about gift horses and their notorious mouths.

"Those are not the conditions,"

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Zarelli said. "The conditions are, one, that my clients will determine how and when the full-scale machine will be used for a period not to exceed six months from the date it becomes operational; and, two, that until the completion of that time there will be no publicity at all concerning what you are doing. It is to be as secret as the work that was done here on nuclear fission during World War Two."

"Absolute secrecy," Pastor said. "Even after this six-month period, you are never to reveal the exact source of the funds or make any statement whatsoever concerning the operations that our clients undertake during that six-month period."

"Those *are* onerous conditions," I said. "Particularly the first. A working time machine under the control of . . . unknown individuals? Whether the time is six months or six minutes, that is still asking a lot."

"There is no alternative," Zarelli said, so flatly that I knew that I could not negotiate my way out of it. I could make a time machine (if I *could* make a time machine) that someone else would operate out of my control for six months, or I would have no chance to make the machine, no opportunity to see if my theoretical work had any practical validity.

"I'm going to need time to consider this," I said after a lengthy silence. "It goes against every ethical fiber I have to agree to such conditions. And, in this case, the results could be more cataclysmic than a million nuclear bombs going off."

"I can offer you one assurance," Zarelli said. "My clients have no interest in altering the past. I assume that that is your primary concern, that they would do something in the past that would have repercussions that would change the present in some catastrophic way. My clients have absolutely no interest in doing anything like that."

"But I would have no way to, ah, make certain of that," I said. "Unless I had the authority to at least . . . veto uses that I considered dangerous, those assurances are, if you will excuse the bluntness, empty."

"We will convey your . . . apprehensions," Zarelli said. "In the meantime, please give our offer serious consideration. We will be in touch with you in a day or two."

As it turned out, it was four days later, the following Monday, before they returned to my office.

"We have discussed this matter with our clients," Zarelli said. "They are reluctant to offer any easing of the conditions I outlined on our previous visit. I told them that unless we could offer you something more, you would likely not agree to the arrangement. After several days of consultations among themselves, my clients have agreed to the following modification. You may be present during any use of the apparatus. If you feel that a particular action that my clients want to take would adversely affect the present by changing what happened in the past, they will stop—time permitting—to at least discuss the situation, give you time to express your concerns. They promise to give those concerns full consideration. But, in the final analysis, the decision on whether or not to

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proceed must remain with them."

That was not good enough. However, I had been doing a lot of thinking. I had found a way that might allow me to agree without giving up total control—a matter of what they didn't know wasn't likely to hurt me. Since they were willing to have me present when the machine was being used, my "out" looked secure. But I wasn't going to agree too quickly. I didn't even know then that I would actually succeed in building a working machine, so I couldn't be absolutely certain that I would be able to add my gimmick to it.

"There is one other consideration that my clients have instructed me to mention," Zarelli said when I didn't respond immediately. "We did not discuss your fee for undertaking this project. Over and above the costs of your work, and a salary matching that which you receive from the university, you will be paid a half million dollars when you demonstrate your proof-of-concept model. When you have a full-scale apparatus working, you will be paid an additional one million dollars. And, at the successful conclusion of the tests that my clients desire to undertake, you will be paid a final five million dollars. All sums will be paid, in whatever form is acceptable to you, with all federal, state, and local taxes already paid on them, with proper evidence of those payments."

Over the weekend it had occurred to me that Zarelli and Pastor might represent organized crime—the Mafia, if you will—and the offer of six and a half million dollars convinced me of it. Neither Zarelli nor Pastor had blinked at the amounts I had quoted during our first meeting and, apart from the government, only the mob might be able to come up with that much money.

That deduction did not affect my decision. As I said before, a researcher has to be open-minded about getting funds. I wouldn't be the first to take money from sources such as that to do research, or to turn research into something more concrete. And it wasn't as if they were asking me to construct a machine for making drugs or anything like that.

Six and a half million dollars, with the taxes already paid. It was that last, I think, that convinced me that the immediate (if not the ultimate) sources of the money would be beyond reproach, from legitimate organizations of one sort of another, money as legally pure as that which pours into the election campaigns of honorable men and women running for public office. And, as I have already said, I had the first glimmers of, shall we say, a private sting operation—just in case.

I needed seventeen months to build my proof-of-concept model and get it working to my personal satisfaction. Satisfying my patrons took most of another month, but, finally, they gave me the go-ahead to construct a full-scale machine. The first model took seventeen months of steady work. I was due a year's sabbatical, so I took that the following school year or I might have needed twice as long to get the first model built and operating.

Since my patrons were satisfied—

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delighted is a more accurate word—with my model, they made it possible for me to take a second year off from my duties at the university without pay. It was not all that much a sacrifice on my part since I had received my first bonus for my work on the time machine. I needed to be free of university responsibilities. Even working more than full time—sixteen to eighteen hours a day, six or seven days a week—it took a year to scale up from the proof-of-concept device to a full-size working apparatus. The difficulties were technical, not theoretical. A sufficient power supply was the biggest problem. It takes a lot of electrical energy to rip a few threads from the skein of time and reach through the gap.

It was just last June, little more than seven months ago, when I first looked on the completed device, as certain as I could be that it would work. After several calibration tests, attended by representatives of my patrons, a time was set for the first major trial of the machine—the first of the runs that were to be conducted for, and at the direction of, my sponsors. I had suggested a series of smaller tests first, to make absolutely certain that there would be no glitches in the operation, but my patrons were far too impatient. They had already waited two and a half years, I was reminded.

"The test is simple," Zarelli told me. Even though a number of his clients were present, he remained their spokesman. "We wish to bring an individual from the past to the present in order to obtain his guidance on a problem that my clients have. After their meeting, this individual will be returned to the exact time and place he was picked up from. Does that pose any ethical problem for you?"

"As long as he is returned to the same time and place, there is no possibility of changing the past, except through whatever knowledge of the present he might gain during his visit," I said. That *did* worry me, but . . . all I can say is that after two and a half years of absolute concentration on the project, I was not as picky as I might have been in other circumstances.

Zarelli shrugged. "His position would not permit much interference. Consider, if you will. You know nothing of time travel. Without warning you are yanked from one time and place and deposited in another. Then, after a brief time in this new place, you are returned to exactly where you were, and are left with no evidence of the reality of your excursion. Tell me, Dr. Wilson, would you believe what you had just experienced?"

I grinned. "*I* might, but I can see that most people would not."

"The gentleman in question is, was, a very pragmatic sort," Zarelli continued. "It is unlikely that he would ever mention the event to anyone, lest it be seen as a sign that he was . . . not in complete possession of his faculties. In addition to which, in the time following the point at which we wish to intercept him, he had troubles enough to deal with. He would not be looking for additional difficulties."

I was curious about the identity of this troubled pragmatist that my patrons were so anxious to consult, but

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I knew better than to ask for his name. Zarelli gave me a date and time, and very precise spatial coordinates.

Although I have refrained from including any technical information about my apparatus, I must at least briefly describe how it functions. My machine is not the sort of thing you might imagine from whatever exposure you have had to films or novels about time travel. There is no mobile machine that flits about in time or space. The apparatus occupies much of a very large warehouse, and requires a considerable supply of electricity. The operation of reaching back in time and bringing a person or object forward consists of two distinct stages. In the first, a window (if you will) is opened on the past scene, and displayed on a computer monitor. That allows final calibration and permits me to pick up precisely what, or who, I want to collect. The second stage consists of *translating* the target to the destination. That can be the location of the apparatus in the present, but the apparatus does not have to be at one terminal of the operation. An object or person can be transported from one remote time and place to another without ever being brought physically to where the time machine is. The operation can also be done in reverse, sending something or someone from the present to any time and place in the past.

The past and present are the only eras available. It is, both practically and theoretically, impossible to go forward in time. The past and present are set. The future is only a quantum cloud of possibilities.

The date I was given was February 14, 1929. The time was 10:27 A.M. The location was in Florida. Zarelli remained at my side throughout the operation. I assumed that he was there to make certain that I did not back out, refuse to complete the procedure once I saw who the target was.

To be honest, the combination of the date and my suspicions about my clients *should* have given me enough data to anticipate the identity of the target. It did not. But when I saw the man on the monitor, I *did* recognize him.

"That's him!" Zarelli said, more excited than I would have thought him capable of. "Bring him in, Doc. Hit the switch."

If I hadn't, Zarelli would have. No more than thirty seconds later, Al Capone was standing in the lab with us.

Wilson looked up. Senator Hitch appeared to be choking to death. Wilson wondered if Hitch had swallowed his cigar. The senator's face was red; he was leaning forward, coughing and gagging. Senator Tavish looked at his colleague with concern. An aide leaned over Hitch, and moved a glass of water closer. After a moment of extreme difficulty, Hitch took a sip. It seemed to help, but his face remained a bright red after he stopped coughing. It was several minutes before he was able to speak, after waving off a suggestion that paramedics be summoned.

"You brought Al Capone to the present?" Hitch demanded, disbelief or shock doing strange thinks to his nor-

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mally well-tempered speaking voice.

"Scar and all," Wilson admitted cheerfully.

"We don't have enough hoodlums of our own? You have to import the most notorious of them all?"

"It could have been worse," Wilson said. "Besides, I figured that Capone would be an amateur compared to some of the talent around today—or at least around at the time I brought Capone forward. If we were really talking about *today,* it would be different, but if I hadn't made the time machine and brought Capone forward, we would still be up to our ears in organized crime, and all that that entails."

"Are you trying to tell us that Al Capone got rid of all of our mobsters?"

"More or less, Senator. He did a good job of eliminating competition in his own time, if you think about it. That's what St. Valentine's Day, 1929, was all about." Wilson waited for a moment to see if Hitch had anything else to say, or if any of the other committee members wanted a turn. When no one spoke, he went back to his prepared statement.

To my surprise, I was invited to sit in on the discussions that my patrons had with Capone, once they had convinced him that he had indeed been pulled decades into his future. I guess that they figured I had taken enough money from them that I was too far in to get out. Maybe they were right.

Capone did not take nearly as much convincing as I might have expected. A calendar, two minutes of watching a television while one of Zarelli's clients used the remote to surf the cable, a look at the front page of that day's *Tribune,* and a glance out the window at the automobiles going by seemed to do the job.

My patrons asked Capone to undertake an important mission for them. They wanted him to eliminate all of the "other" gangs, the Colombian, Asian, African-American, and so forth. The idea was for Capone to collect gunmen from his own time. They would be moved from spot to spot, with people who knew the targets. The gunners would be returned to their own time when the job was done, away from any possible prosecution. When the operation was over, Capone would be paid a sum even more outrageous than what my patrons had offered me—in gold bullion.

It was at that point that I offered a suggestion of my own. "I think I can make this all a lot safer and simpler." Most of the people looked at me as if they had forgotten that I was there. The stares were enough to start the flesh crawling up and down my spine.

"How?" Zarelli asked after one of the principals gave him a look.

"The machine," I said. Maybe I was on the hook too much to get out, but I had no liking for the bloodbath they had in mind. "Pinpoint the targets the way you did Mr. Capone's location. We move them somewhere—some*when*—where they can no longer give you any problems. They simply disappear, more completely than if they went swimming with concrete boots. No trouble with the law. No bodies to dispose of. No chance of los-

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ing any of your own people in the process. Nice and tidy."

Almost as soon as the words were out of my mouth I regretted mentioning concrete boots. Those men were not the type to take levity well. There was a period of silence. Capone and my patrons looked around at each other. There were shrugs, facial gestures, cocked heads. They did more business with body language than some groups of people can do with millions of words.

"You've got a smart boy there," Capone said after a minute or two. He looked at me. "Do it neat."

Another thought came to me. If my patrons did it *my* way, Capone might be out ten million dollars. Once *he* realized that, he might be less kindly disposed to me. "Of course, things can go wrong," I said. "It would be best to have an expert on hand with the people to take care of anything like that."

Capone grinned, then laughed out loud. "I like this kid," he said. He walked over to me and pinched my cheek. "I like you. What's your name?"

I told him.

"Well, Bill Wilson, you got a good head on your shoulders. You use it to think. I could use someone like you."

"Thank you, Mr. Capone, but I'm booked up solid with these gentlemen."

The principals agreed to act on my suggestion, with Capone handling security. We moved to a restaurant for a banquet. The rest of my sponsors showed up for that. Everyone wanted to meet Capone, talk with him, have their pictures taken with him. The party went on into the wee hours of the morning.

The next day the real work began. During the first couple of months it went slowly, as the targets were tracked and we worked out the necessary routines. Then, just after the elections last November, the operation went into high gear. By Christmas it was over. And now, here I am.

Wilson assembled the pages of his statement, tapping the sheaf on the table in front of him several times. He looked up at the senators. At some point, Senator Hitch had left. The gap at the bench was as obvious as a missing tooth in a wide grin.

"I will be delighted to answer any questions," Wilson said.

Senator Tavish looked around, as if he wanted to be absolutely certain that Hitch was gone, then cleared his throat. "It's almost time for us to recess for lunch, Dr. Wilson, but I would like to ask a couple of questions before we do."

Wilson nodded his acceptance.

"Assuming that it was the Mafia who financed your machine, and that you got rid of all of their competition from other ethnic and national groups, what happened to them? The reports this committee have received also indicate that no known Mafia members have been seen since Christmas either. I doubt very much that they hired you to get rid of all of the competition and then retired *en masse* themselves."

"No, Senator, they certainly did not. But you have to understand, sir, that this was a *massive* operation. I was working eighteen hours a day, seven days a week. We had to find and trans-

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port literally tens of thousands of individuals, and we had to work quickly, before significant numbers of them could 'take a powder,' once they realized that something serious was up. That meant that my patrons had to put virtually every man and woman on their payroll into the operation, spotting, and being ready to respond to any emergencies—their SWAT teams, you might say. The last two days. . . ." Wilson stopped and shook his head slowly.

"I finished the operation in one thirty-six-hour stretch, non-stop. When I got to that point, I *had* to work fast, before one of my sponsors realized what I was up to and decided that I should be eliminated. Up until the point that I started operating against my employers, I felt safe. The machine needed attention often enough that only I could provide. They *had* to have me to use the apparatus. And the time I had spent working on getting rid of their competitors had given me plenty of opportunities to study my patrons and their, ah, traditional employees. I had to get the right people first, scramble their command and control structure, to use the military idiom. My employers were very paranoid about security matters, and that worked against them. I got rid of them all, every last one of them, including Zarelli and Pastor. I shipped them all out, right down to the people who were there to keep watch over me."

"All of them?" Tavish asked.

"Everyone who was targeted for me, everyone I knew about. The exception was Capone and the people we brought forward to help him. I returned them to their proper places. Capone went right back to his Florida home the morning of the St. Valentine's Day Massacre. That was inescapable. If he had disappeared in February 1929, it might have altered history." Wilson shrugged. "Besides, I sort of enjoyed his company, even with all I knew about him. As for the rest, I'm sure that there must have been some who escaped, who were missed, but not enough to pick up the reins. As long as the police stay vigilant, it should be a lot easier to make our cities and towns safe again."

Tavish glanced at a clock, looked around at his colleagues, then finally turned to Wilson again. "*Where* did you send them?"

Wilson's smile grew even larger. "A place and time where their talents and proclivities could pose no threat to the locals. I had to be very careful. I had to make certain that I didn't send them anywhere, or anywhen, where they might alter history, alter our present."

"Where—*when*—was that?" Tavish asked.

"The early Cretaceous, Senator, back when the neighborhood bullies were dinosaurs."

The hearings continued for another week and a half. Dr. Wilson freely answered all of the questions put to him by the committee and by the press before and after the Senate sessions except in two areas. He steadfastly refused to give any details, even in the broadest form, of the time machine's construction. And he refused even under threat of contempt of congress to

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say where the machine, or its components, were currently located. All he would say on the latter subject was, "I disassembled it immediately following the conclusion of the project and moved the parts to other locations."

Among the things he did not say was that he had since reassembled the apparatus, and that it was now located within a half hour's drive of the Capitol Building.

There were no hearings scheduled for the day of the President's State of the Union Address. Wilson spent most of that day in his hotel room, watching television. Late in the afternoon, he left the hotel by a rear entrance, disguised with a navy blue watch cap and a surplus Army overcoat. None of the FBI agents, police, private investigators, or news people watching the hotel spotted him.

He made the drive to the Virginia location where he had reassembled his time machine. That evening, a little after nine o'clock, he turned the machine on.

He had the exact coordinates prepared. The only question in his mind was whether the machine could handle the overload. It had not been designed for anything quite so . . . ambitious.

In just a couple of minutes, the computer monitor was showing the same scene as the portable television sitting next to it, the House of Representatives. The chamber was crowded with the Vice President, senators, Supreme Court justices, cabinet members, diplomats, and the Joint Chiefs of Staff all present in addition to the representatives who normally worked in that hall. The President of the United States was introduced and escorted down the aisle to the dais. As soon as the President started his speech, Wilson hit the switch on his machine.

"And that cuts the head off of the *rest* of organized crime in America," he whispered as his television showed an empty House. He leaned back and put his feet up. It had been a good day's work.

The cigar he lit was Cuban, the best handmade rolled in 1929, given to him by Al Capone himself. As soon as he was finished with the cigar, Wilson would use his time machine for the last time. He already had the explosives packed around each piece of equipment. A timer would take care of it all two minutes after Wilson arrived in 1929 Florida.

Mr. Capone had made him an offer he couldn't refuse. ■

Long, long, ago whan Ursa Major was named, bears probably looked a lot more like dippers than they do today.

—Will Cuppy

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THE LIMITS ON TECHNOLOGY

In 1981 I made an audacious general forecast of the future: "We will be able to do anything we want to do, provided we are willing to pay for it and to live with all the consequences."

It appears that I was right, but in ways that I *didn't* forecast or expect.

Technology is nearly to the point where we can indeed do anything we want within the next 50 to 100 years. However, limits are being placed on technology not by the Universe but by people themselves. This was brought home to me by three recent examples.

Our biotechnology—including medical technology—is truly incredible in comparison to what it was even 50 years ago. The popular medical television shows give some indication of this. However, in spite of technology that can literally resuscitate a person who would have been pronounced dead even 20 years ago, sometimes it cannot be used because of the bureaucracy that has grown around it.

A member of my family was recently involved in a head-on automobile crash at a closing speed estimated to be in excess of 40 miles per hour. The car was totaled, but her life was saved by the seat harness (no air bags). The paramedics took more than 30 minutes to get there, decided her vital signs were stable, and left. When I arrived 60 minutes after the accident, having been notified by the policeman on his cellular telephone, she was conscious and barely ambulatory but showed signs of going into shock. I put her in my car and drove her to the nearest hospital with a trauma center (emergency room). They got her stabilized, but only after I produced the necessary medical insurance cards from her wallet. Then it turned out that the hospital wasn't one of those authorized to treat persons using her particular health maintenance organization. Therefore, in the middle of the night a mere five hours after the accident, she was transported by ambulance to another hospital 15 miles away. The hospital finally got permission from her HMO to run tests to determine if she had any internal bleeding. She wasn't seen by the MD on call from her HMO for 13 hours after admission. The following day, she was released from the hospital to a rehab center and transported about

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13 miles away. There, after 24 hours, they released her. She could barely walk from the bruises and contusions suffered in the accident. (Did I mention she's 82 years old?) I drove her back to her apartment because the HMO bureaucrats decided that her medical insurance didn't cover anything once she was released from the rehab center where nothing had been done. The medical bureaucracy—*not* a medical doctor—had determined that she needed no further medical care.

My wife does medical transcription work translating taped dictation from doctors into hard copy reports via a computer word processor. She tells me this incident isn't unique.

My father was an MD. On a vacation trip in 1951, I remember stopping alongside a highway at the scene of an accident because people were hurt. He gave emergency treatment to the injured, followed the ambulance to the nearest hospital, and made sure they were in good medical hands . . . all without any compensation because *he was a doctor.* In spite of the good Samaritan laws in effect in some jurisdictions, that sort of medical attention would be impossible to obtain today *in spite of the fact that the medical technology is 45 years better!*

Here's another example of the limits being placed upon technology: We have the know-how to build and operate safe, reliable, economical, reusable single-stage-to-orbit (SSTO) spaceships that could open the Solar System to humanity. We are not building them because of (guess what) bureaucracy supported by politics. As I mentioned in a science fact article in an earlier issue of this magazine, we may not be allowed to fly the spaceships when we finally manage to break through the "it-can't-be-done" syndrome of the old-time engineers and turf guards in NASA and the aerospace industry.

One of the first hurdles to overcome was the assertion, "We can't build a rocket whose gross takeoff weight is 90% propellant." That was temporarily squelched when historical data was presented showing that the Atlas-E, Titan (all models), Saturn V (all stages), Zenit, and Energia all exceeded this propellant fraction by as much as 5%. (In 1945 the US Navy's Bureau of Aeronautics proposed a High Altitude Test Vehicle or HATV that was an SSTO; it was the brainchild of an engineer at the Naval Aircraft Factory in Philadelphia whose name was Robert A. Heinlein.) Then we were told, "Those were expendable vehicles and we cannot build a robust reusable vehicle with a 90% propellant fraction." In my archives, I have several final reports from major aerospace companies that state as long ago as 1967 they could build reusable SSTOs. The only way to show that such a "robust" reusable SSTO can be built is to build one . . . but that's what the bureaucrats and turf guards do *not* want to happen!

The next hurdle: "There's no market to support an SSTO. Only three vehicles will be able to handle all the payloads that we can forecast out to 2015." In the meantime, potential satellite suppliers such as Motorola,

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Teledesic, and Hughes plan to launch more than 1,600 satellites before 2005. (Through the halls of history echoes the statement of the 1949 IBM market study that nine vacuum-tube mainframes, their Selective Sequence Electronic Calculators, would be "adequate to handle all the data processing and scientific computing tasks of the entire United States for decades to come." And the statement, "640K of memory is all anyone will ever need," from a young man named Bill Gates in 1979.) Of course, the jack-leg marketeers from NASA and the aerospace companies don't *want* more than two or three reusable SSTOs because they don't understand that these vehicles will produce a revolution, not the evolution they want. Most of them cannot produce a proper business plan. Think not? How many rich bureaucrats or aerospace engineers do you know?

They're using technology they don't understand to halt or slow a technology they don't want.

These two examples involve technology that most of us *say* we want. We're unhappy when the bureaucracy limits them. However, be careful about condemning technology limitation before learning about the third example.

Hughes Aircraft Company in Tucson, Arizona has developed and perfected several excellent examples of "dual-use" technology—i.e., developed for national security use during the Cold War and now being proposed for commercial use.

One of these is the "smog dog," a little box full of microelectronics that sits alongside the road and measures the exhaust products of individual passing automobiles. When it detects a car having an exhaust whose pollutants exceed the government-imposed standards, it can photograph the license plate and inform public safety authorities. It has millisecond response time. It's in use in the Phoenix metropolitan area now.

A variation of the "smog dog" uses video sensors to monitor intersections, detect autos that run red lights, photograph their license plates, and notify the police. The unit can also monitor the speed of a vehicle, photograph the license plate of the offender, and immediately report the data to the police.

Most people are in favor of the "smog dog" and the other traffic sensor systems until other applications of this equipment are pointed out to them. The technology can also monitor the position and location of any vehicle at any time and thus keep track of who's going where and when. "Big Brother" isn't the name of this gadgetry yet, but the potential applications of it are indeed Orwellian. The Drug Enforcement Administration would *love* to have these gadgets to monitor vehicles crossing into the US from Mexico. So would the Immigration and Naturalization Service. Question: If federal (or even state) agencies get these devices, are you certain that other federal agencies *won't* take advantage of the technology? Ask yourself: Do *you* want technology out there that's capable of monitoring where you go in your car and keep track of it for months or years? You

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may not care, but do you want your spouse or boss to get the data?

Here's another one from the aerospace industry: A portable millimeter radar with characteristics that allow it to look *through* the walls of buildings (and houses) to "see" what's going on inside. It exists.

Therefore, do not immediately react in one way or the other when the question about the control of technology comes up. Oh, do you mean you don't want *any* controls on Technology X but strict controls on Technology Y and different ones on Technology Z?

The control of technology—who exercises the controls, what the controls are, and what the limits of its use will be—is and will continue henceforth to be an issue of supreme importance in our twenty-first century civilization. The decisions cannot be left to engineers and technologists any more than politicians and bureaucrats. The former are too enamored by the technology and the total freedom they enjoyed while developing it; the latter cannot be trusted to control it without destroying what the former consider to be personal freedom.

A balance must be struck. It will be a compromise. It always has been. Furthermore, it must be a dynamic compromise that changes with time because technology and civilization itself will change as a result of the interaction.

And these issues *cannot* be ignored because the technology that created these three examples is *already in hand*. Whether the situation involves the application of medical technology to a family member, the development of inexpensive and reliable space access for all, or the use of sensing and imaging technologies for law enforcement, personal and community interests will conflict. Therefore, don't shoot the lawyers . . . yet. They're specialists in the non-violent resolution of interpersonal conflicts. Make friends with a lawyer if you want to make the future happen the way you wish.

In the past, similar issues have been faced and solutions found. The issues relating to the technologies of hydrology and agriculture were no less important to the ancient Sumerians. They solved them. I have confidence that we are at least as smart as they were and that we can therefore solve these current problems.

As usual, I never promise to answer questions, only to bring interesting issues to your attention. I can't save the world alone. Start thinking about solutions. And don't forget: Be careful what you ask for because you'll get it. All of it. ■

To believe with certainty, we must begin with doubting.
—Stanislaw I of Poland

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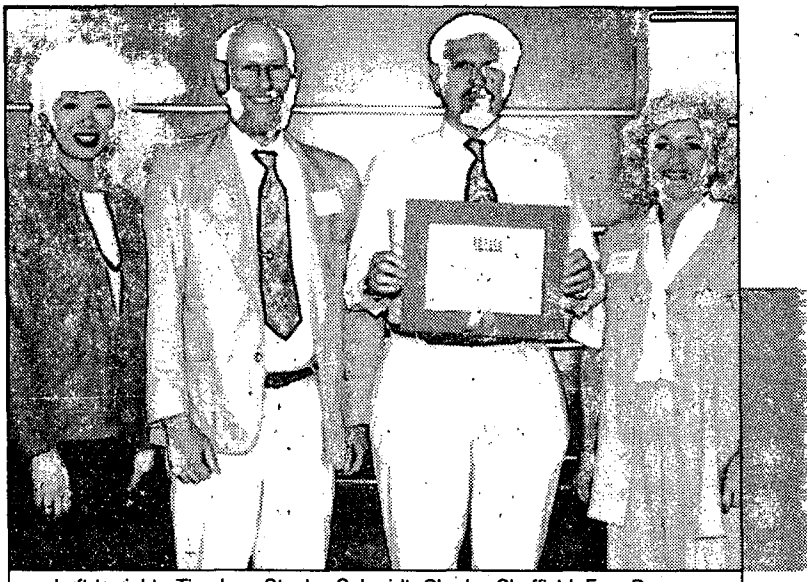

Left to right: Tina Lee, Stanley Schmidt, Charles Sheffield, Fran Danon.

The Analytical Laboratory awards breakfast was held April 27, 1996 on the *Queen Mary,* at Long Beach, CA over the Nebula Awards weekend. Joining us on this happy occasion was Charles Sheffield, whose fact article "A Handful of Heresies," won for best fact article. Unfortunately Gregory Bennett, winner in the best novella category with his story "Fish Tank," Doug Larsen with his first-place novelette "A Portrait of My Grandfather," and short story winner Michael Burstein with "TeleAbsence," were unable to attend. Also missing from our table was artist Bruce Jensen, whose Mid-December cover for "Unfinished Symphony" captured first prize.

Photo by C. N. Brown/Locus

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Ted Reynolds

THE HAMMERPOND PARK BURGLARY

Crime, like everything else, must adapt to changing times. . . .

Illustration by Kelly Freas

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One might well ask whether modern burglary is practiced as an art, a hobby, or politics. Some of the most noted practitioners seem to hold to each or any of these motivations. Pride in precise accomplishment seems to point to the esthetic, disinterest in any material gain to the playful, and disrespect for unshared possessions to the envious sides of human nature.

The object to be burgled in this particular instance was a certain Frigart sketch, well known as a unique item of great value. In marrying its creator and possessor, Gal Aveling had become at one stroke the wealthiest person on the Coil. The Gal was already known for her numerous impressive qualities, of which modesty was unfortunately not one. She had all the social presence of a lump of creosote. Now she was also a psychoeconomic force, which drew the attention of the leveling section of society, among which burglars, both by habit and by principle, were well represented. The most respected of these in the Coil was Teodora W@kins, and she was appointed by her set to remedy the situation.

Being a woman of some notoriety due to previous exploits of a comparable kind, W@kins decided upon an unobtrusive approach. She selected the role of a mood-hound and the barely noticeable name of Mir&a Wriggle. She set her personal replicator for a thirty-hour clone, stepped through, and breathed a sigh of relief as she realized *she* wasn't the clone. Simultaneously the clone breathed a sigh, perhaps of sad resignation on realizing that she *was*.

Having sent the other one of her off to perform some necessary preparations, (if you can't trust yourself, who *can?*) W@kins duplicated a clean wardrobe, grabbed a couple of pocket replicators, and started for Hammerpond.

Now Hammerpond is such a cutesy-tricksy little twist of the Coil as you can't imagine till you've been there. It's rated in 23rd ¢ury at 60% Actual, 33% Shared, 4% Random, and the rest Up-For-Grabs. All this with a Consistency/Security Index of 92.7 and holding—no wonder it's largely ignored.

Still, there are enough little bits of abutting landscapes, neuroses and weather to draw quite a contingent of inner-experience seekers. Thus W@kins was greeted on her arrival by half-a-dozen other mood-hounds. It would have made her feel less conspicuous if she had been more competent to cope with their lingo.

"Have you had many unique experiences?" said the person called Porson. They were sitting on onyx mushrooms and drinking chocolate toddies at Rustie's Placebo. This Porson had no notion he was being pumped.

W@kins *wanted* to respond "How would I know they're unique?" but said instead, "Not often. Just this and that, you know."

"Ineffable?"

"Of course. And in the Net."

"Are you a decent channel?" said the Porson person.

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"Don't fade me," said W@kins. "I'm hard disk."

"I mean, do you record well?" said Porson.

"Erase that right now," said W@kins suspiciously. "You're talking like I'm rebooted."

Porson *was* a reboot, and genotypically incapable of even imagining criminality; completely at a loss, he tried to divert the conversation.

"I like your eyeclip."

"Do you? Here." W@kins passed it through her pocket replicator and handed one to Porson.

"What are you here to experience?" asked Porson.

"I thought I would experience the Hammerpond Park at night," said Teodora W@kins.

"Well, yes, but . . . how? Naturalistically? Romantically? Fearfully?"

"I thought," said W@kins shortly, "I'd just experience the Park first, and add a mood later when I found a proper one."

Porson looked stunned, which was all right with W@kins, as it kept him quiet.

Her toddy mug, a hollowed-out ruby with sapphire inlays, (everybody had one) was half empty. She poured the remainder through her pocket replicator to refill her cup.

"It is stated," said old Rustie, the usuform barobot who ran the place for old program's sake, "that there are a minimum of three guards on duty at all times in the Pond House. Protecting the Frigart sketch is their main responsibility. One is doing it for the prestige, one for the emotion, and the third as a punishment. Why, thank you, lady or gentleman."

The next evening found Teodora W@kins in the Hammerpond Park, a null zone strategically surrounding the Pond House. She tried to look as if she were a typical mood-hound, ecstatically feeling something unusual in the totally unmodulated area. The other one of her showed up just after sunset, and they conferred in low voices, as one must in a null zone.

Twilight deepened; first one, then another orbital complex appeared in the darkening sky. The thundering of the rabbits undergoing forced evolution in the nearby rotaries diminished and ended in complete silence. The Pond House itself, a tastefully replicated mix of Taj Mahal and Sans Souci with a touch of Waldorf Astoria, blessedly lost all the details of its architecture and became a dark gray outline.

Both of her cautiously approached the shadow of the looming Pond House and squatted near the corner. Pulling out a pocket replicator, she dismantled it into its component struts, nodes, plates, and batteries. Fishing the second replicator out of her pocket, she poured the components of the first through it, repeating the process with the resultant parts several times. She spent several minutes reassembling a two-foot long replicator. Through this, she could now pass herself larger pieces, and the process moved faster. Plates dovetailed into larger plates, batteries hooked up in series, struts pushed out in meter lengths. At her signal,

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her clone began laying the whole construction out along the base of the shadowed wall.

Suddenly, close beside W@kins in the bushes, there was a violent crash and a smothered curse. Someone had tumbled over the extended struts that had just been deployed. She heard feet running toward her from both directions. With a true artist's distaste for premature publicity, she began running from the house on her own.

Running in a null zone is a drag. It's dream running, and focusing attention is very difficult. She was indistinctly aware of at least two people hot upon her heels, and she didn't think that they were both her clone.

There was a scuffle behind her. Her clone had obviously not been fast enough, and was engaged in unsavory physical activities with persons unknown. She considered going back to aid her other self, but rejected the notion when she remembered it was just a short-timer anyway, who wouldn't last long enough to inform against her. She turned to tiptoe away from the struggle in the dark behind her, when a queasy internal feeling led her to a reinterpretation of the situation.

"Damn! I *am* the clone!" she thought as she stopped being anything.

The original Teodora W@kins was meanwhile dealing out a pummeling only half as good as she was enduring, as she had two assailants to contend with. It felt like they were trying to stampede across her body crosswise, but as there were hairs to pull and groins to knee, her time was neither completely unoccupied nor totally unsatisfying. But consciousness was definitely on the wane, when the struggle abruptly terminated.

When her sensations became less entangled she was sitting upon the turf, and eight or ten persons—the night was dark, and she was rather too confused to count—stood round her, waiting for her to recover. She mournfully assumed that she was captured, and might have philosophized on fortune's fickleness, but she felt sick to her stomach.

She noticed that she was not under restraint, and then a flask of liquor was placed in her hand. It was Drambuie—well, why not?

"She's coming out of it," said a voice.

"We've caught both of them, ma'am," said another voice, deep and authoritative. "Thanks to you."

No one answered this remark. Yet she failed to see how it applied to her.

"She's been knocked silly," said someone else. "Those levelers half-killed her."

Teodora W@kins decided to remain knocked silly until she got a better hold on the situation. She perceived that two of the dark figures near her were under restraint, and that neither was her clone, who should be out of the picture by now anyway.

"I am very much obliged to you," said a woman out of the shadows. "You have prevented a serious theft. Allow me to introduce myself. I am S&ra Aveling, owner of this establishment."

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"Very glad to meet you, Gal Aveling," said W@kins.

"I presume you saw these creeps stealing about the premises, and took after them?"

"That's about it," said W@kins.

"It was lucky for you," said the Gal, "that the guards spotted you chasing them. I doubt you could have taken them both—though it showed an awful lot of grit to try."

"One can only try," said W@kins, "and trust to fortune."

"Quite, quite," said Gal Aveling. "I'm afraid you have been roughed up a bit." The group was moving toward the house. "You're limping a little. Let me help you."

So instead of having to replicate the whole house to achieve her purpose, Teodora W@kins entered it—slightly stoned, and quite cheerful once more—on the arm of a real Lady of the Mob, and through the front door. "This," she thought, "is what I call a cool burgle!"

The "levelers" proved to be mere local amateurs, driven by personal envy. They were taken into the lowdowns and there watched over by the three guards, two humanoids, a usuform, and six-hour clones of Gal Aveling and her spouse, until the dismantlers arrived. W@kins, on the other hand, was made much of in the upper chambers. The Gal replicated the master suite for her and would not hear of her departure that night. The spouse said she was surely a unique individual, and said his idea of Simone De Beauvoir was just such another vague, half-stoned, sharp-eyed, brave, and self-effacing woman. Someone brought up a remarkable set of replicators that had been found in the shrubbery, and explained how it could have connected up to replicate the whole house.

And they showed her the Frigart sketch in the strong-room.

"My spouse did it with Crayola when he was three," said Gal Aveling. "His father had the cameras already set up, and the guards and witnesses ready. It's never been touched since. One of the few authenticated unique items left in the world. Untold value."

W@kins looked at the lined yellow paper with the vivid colors scrawled over it. "It looks hideous," she said.

"Doesn't it?" said the Gal proudly. "True Frig Art."

W@kins had the sense to turn down the offer of a short-time clone of the Gal or her spouse for the night, pleading her own internal bruises acquired in the heroic chase. She was finally seized with severe yawning; her hosts immediately apologized, and led her to the replicated bedroom, next to Gal Aveling's own.

Artistic expression, sportive diversion, or social statement—modern burglary is hard to categorize.

When Gal Aveling found that her overnight guest had silently departed in the morning, she rushed at once to the strong-room. When her eyes fell on two *identical* scrawled pieces of yellow-lined paper, she knew she had been totally cleaned out. ■

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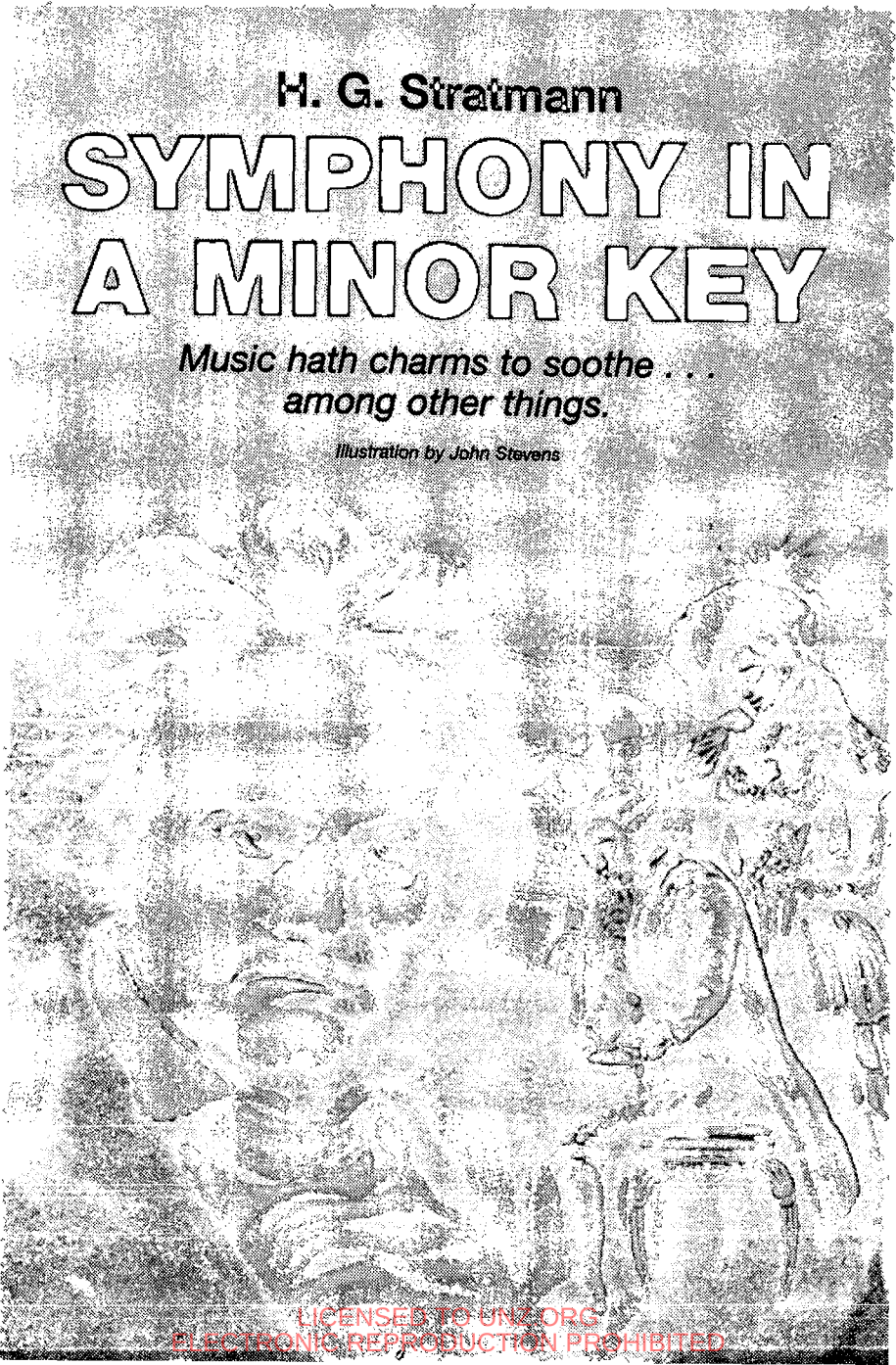
H. G. Stratmann

SYMPHONY IN A MINOR KEY

Music hath charms to soothe . . . among other things.

Illustration by John Stevens



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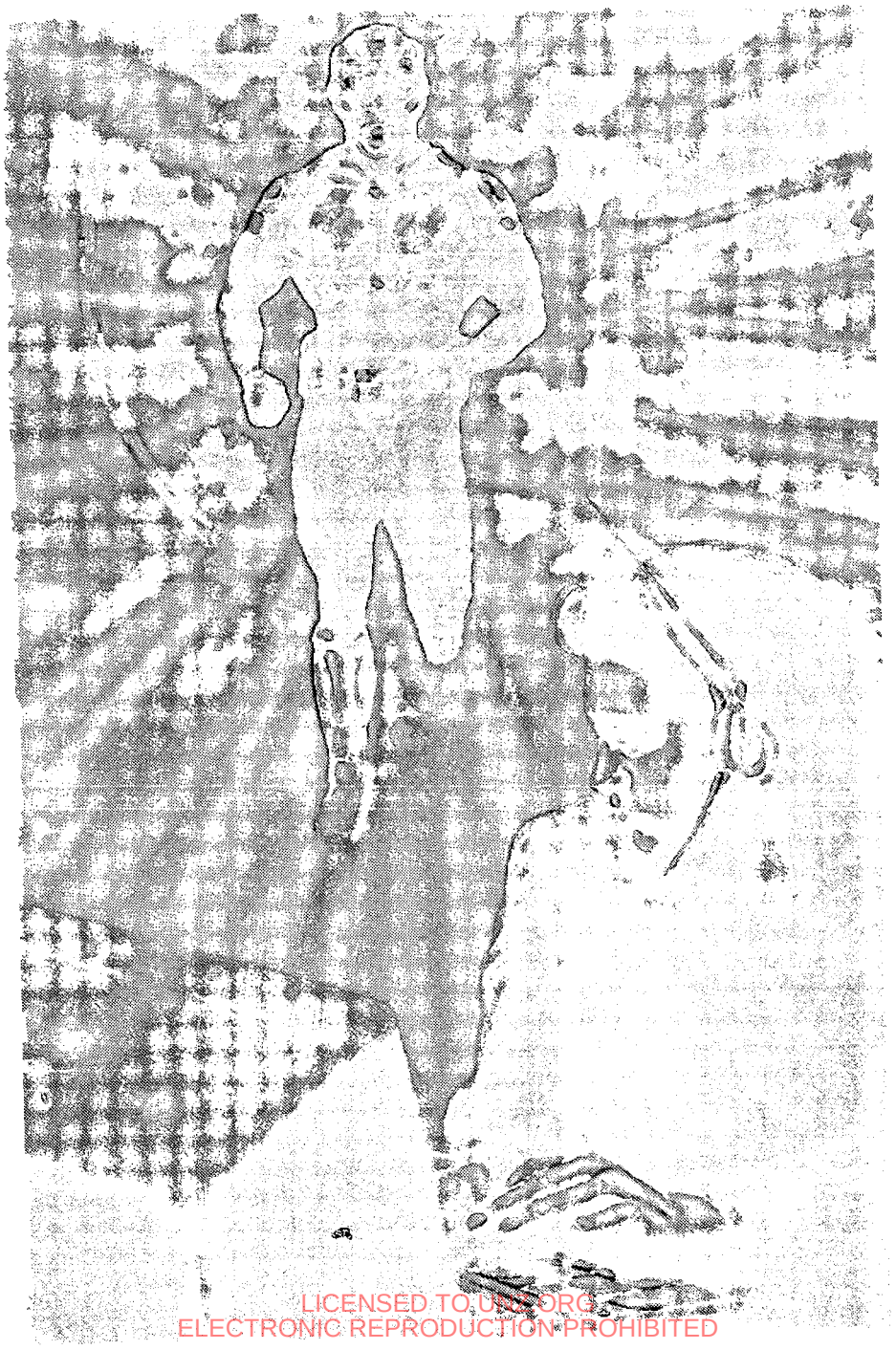

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Introduction

As he emerged from the alley the front of the building on his right exploded. Knocked down by the blast, Robbins staggered back to his feet, unable to comprehend what he saw.

The city was deserted and in ruins. Most of the nearby buildings were at least partly destroyed. A few were on fire, spewing acrid black smoke into the cold air. The wide street he stood on was pockmarked with craters and littered with broken wood, glass, and the torn bodies of dead animals. In the distance he heard unintelligible cries and screams, sharp firecracker-like snaps, and whistling sounds like descending skyrockets followed by thunderous explosions.

Suddenly a horse-drawn wagon whipped around the nearby street corner and bore down on him. Both the driver and the gray-faced woman at his side looked terrified as he lashed the horses to greater speed. The wagon grazed Robbins's arm as he jumped aside just in time.

Before he could catch his breath, a portly red-faced man puffed around the same corner and sprinted toward him. As he ran past, Robbins grabbed the stranger's arm and shouted at him in German, "What is happening?"

The fat man's eyes bulged. "Let go of me, you fool!" he screamed. "They're right behind me, they'll kill us all!"

Before he could ask who "they" were the man broke free and resumed his headlong flight. As Robbins started after him an arcing shriek tore through the air. Suddenly the part of the street just in front of the fleeing man exploded, flinging him backwards high into the air, arms flailing wildly, until he landed on his head with a sickening thud.

Robbins ran to him. The man lay on his back, bloodied mouth gaping wide, unmoving eyes staring up at the sky. Dead.

Then he heard more hoofbeats coming from the other end of the cobblestoned street. Recalling the dead man's last words, he looked around for a place to hide. The closest shelter was the crater just blasted in front of him in the middle of the street. It made a shallow foxhole, deep enough to let him duck his head below street level by lying on his stomach. Ignoring the mud staining his clothes, he peeked over the edge of the crater.

Four horsemen turned the same street corner from which the wagon and the dead man had just come. They wore identical tall black woolen hats, brown shirts open at the neck, wide red sashes around their waists, and dark pants stuffed into high military boots. A long saber hung from each one's side. Their bearded faces too seemed identical, with coarse, menacing features.

Seemingly oblivious to his hiding place or the distant thunder of cannons, they trotted their horses down the street at a leisurely pace, directly toward him. Every few meters they would stop momentarily and peer at the surrounding buildings, as if looking for someone.

Quickly Robbins ducked his head

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back down, heart pounding. The alley from which he'd emerged—the one containing the portal back home—was too far away. If he tried running to it, they would see him, and could cut him down with their sabers long before he reached safety.

And if he did nothing, in a few minutes they would, literally, be right on top of him.

The melody of the Russian dance from Tchaikovsky's Nutcracker *ballet flashed through his mind. He was about to be killed by—Cossacks?*

Confused, desperate, Robbins closed his eyes. Like the bass part of some diabolical passacaglia, a single thought repeated itself in his mind.

What in God's name is going on?

Exposition

"—And we have no right to play God!"

H. L. Robbins, head of the musicology section, looked anxiously at the other members of the humanities committee seated around the conference table. Then he sighed with relief. Except for Billingsley, who was grinning at her, the other Section Chiefs seemed unmoved by Brentano's tirade.

At the head of the table, the chancellor of the Institute for Transcosmic Studies frowned at Brentano. "Thank you for your comments, Dr. Brentano. However, before we discuss whether Dr. Robbins's proposal should be carried out, we need to establish whether it is even feasible. That's why I've asked our distinguished guests from the science committee, Drs. Everett and Harrison, to come to this meeting."

She nodded toward the elderly woman seated at her right.

Catherine Everett, Ph.D. glared back. "I gave my opinion in the report I sent to your committee." Her eyes flashed around the table. "I assume you all read it?"

From the embarrassed looks on the faces of his colleagues, Robbins doubted any of them had been able to figure out what Everett's report said either. He, for one, had no idea what terms like "closed temporal loop" and "quantized timelines" meant. And as for the equations—.

The Chancellor said diplomatically, "Perhaps you could summarize your conclusions about the possible dangers of traveling back in time and changing the past."

"No, no, no!" Everett shouted back. "There's no danger anything we do on Transcosmic Earth can affect us! Translocating there may seem like simple time travel into the past, with all the possible paradoxes and violations of causality that implies, but it's actually much more complicated! Anything we change there would simply replace TCE's current history with one of a nearly infinite number of different 'shadow histories,' and make it the 'real' one instead. But our history would stay the same!" She launched into a monologue about "temporo-quantum discontinuities" and "branching universes" that Robbins couldn't begin to follow.

But even if he didn't understand it, Everett must know what she was talking about. She had originated the theory of "transcosmology" that let them travel to Transcosmic Earth. Appar-

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ently, Everett and the other physicists at the Institute disagreed about what TCE was—their own Earth's past, a "parallel" world, or something else. Whatever it was, you could "translocate" to anywhere on it within a roughly 400 year "temporal window," stay as long as you liked, then return to "their" Earth an equal amount of time later.

Nobody he talked to seemed to know why you couldn't travel back farther than the mid-seventeenth century, or more "recent" than 1998. Rumor was the last six decades were "off-limits" because the members of the Executive Committee who oversaw the Institute didn't want anyone alive today to be embarrassed by anything discovered by observing their younger analogs on TCE—especially themselves. Unlike his colleagues, Robbins didn't feel those limits hurt his work. In fact, it was because of his expertise in pre-twenty-first century Western music, whose "golden age" fell within those years, that he'd been invited to join the Institute for Transcosmic Studies.

The institute was the result of an international effort to use and regulate translocation. Its purpose was to "go back in time" on TCE and collect information and "cultural artifacts," like music, that had been lost on their own Earth. Along with a monopoly on its use, the institute was responsible for ensuring translocation wasn't misused. There was one rule, the "First Law of Contact," that every member of the Institute had to obey at all cost. Anyone going to TCE was to have as little contact with the people there as possible, or do anything that might change its "past."

It was this rule that Robbins was proposing to break in a very big way.

"—And that should answer your question!" Everett folded her arms.

The Chancellor looked as confused as the rest of them. "Then I take it you believe we can alter TCE's past without changing our own?"

Everett's face turned crimson. "Of course! That's what I just said! Weren't you listening?" Cowering like everyone else, Robbins thought it amazing that this short, grandmotherly woman with silver hair pulled back severely into a tight bun could make the lot of them—all experts in their fields, and several nearly her age—feel like grade-schoolers being scolded by a strict teacher.

"Let me put it even more simply. Transcosmic Earth was the timeline that initially produced us. But ever since a temporo-quantum event made our current Universe branch off from TCE, there's no longer any 'causal' relationship between our timeline and TCE's. Now, TCE is no longer 'the' past, but only 'a' past—one we can change without affecting the unique past, or the present, of our own branch Universe. To use a crude analogy, just as a newborn baby, once its umbilical cord is cut, exists completely separately from its mother, and continues to exist despite what may happen to her, our Earth and its timeline now exist independent of TCE.

"What Dr. Robbins proposes will prove what I've been telling my denser colleagues and the executive committee for years. We won't

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change our own 'remembered' history, we won't 'blink' ourselves out of existence by changing TCE's history!"

The Chancellor nodded politely. "Thank you, Dr. Everett." She turned to the white-haired man seated on her left. "Dr. Harrison?"

Cecil L. Harrison, M.D. began, "Dr. Ertmann, the physician on my staff with the most experience in field work on TCE, made a series of nocturnal visits to the subject's apartment starting two years before he died and collected blood samples while he was sleeping. Postmortem tissue samples and ascitic fluid were also obtained hours after he died. Our analysis of the specimens confirmed the opinion of his own physicians that he died of liver failure. However, they erroneously believed it was due to alcohol abuse or syphilis. Using tests not available in the nineteenth century, Dr. Ertmann and I found it was actually caused by chronic active hepatitis, from an infection with the hepatitis B virus he contracted no more than fifteen months before he died.

"Thus, to prevent his death, we only need to give him an injection of an appropriate medicine at least a month before he was infected. Nanoscrubbers block entry of viral DNA into cells, and have a success rate of nearly 100 percent. However, 'scrubbers stay in the blood and other bodily fluids, and anyone else exposed to them after he was injected could also become immunized. Since it was emphasized to me that only the subject himself should be affected by what we do, I suggest immunoboosted hepatitis B vaccine be used instead. Its average success rate is still 95 percent, and it wouldn't affect anyone besides him."

Harrison coughed. "Bear in mind, however, that at the time he died he had other medical problems which, even if we prevent him from dying of hepatitis, will still eventually kill him. I estimate he'll live about five, and certainly no more than ten extra years."

"Thank you, Dr. Harrison," the Chancellor continued. "Our guests tell us there's no technical reason why Dr. Robbins's proposal can't be done. Now we must consider whether we *should* do it. Drs. Robbins and Brentano have already expressed their positions. Are there any other comments?"

Now, Robbins thought, was the moment of truth. Brentano was adamantly against it. But right now it was dangerous, politically speaking, for anyone to side with her. She and the philosophy and theology section she headed had been in disgrace with the executive committee since their report on what really happened at Lourdes in 1858 had leaked to the public. The Vatican had shrugged it off, saying no official articles of faith were involved, just a popular tradition. But the crowds protesting outside the Institute compound, and whoever had sent the bomb threats, disagreed. The formal complaint sent by the French government, presumably on behalf of their tourism industry, hadn't helped either.

Lytton and Shimura should be on his side. If his proposal was approved and set a successful precedent, they had similar proposals of their own to submit.

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Billingsley, as always, was an enigma.

Shimura said, "Dr. Lytton and I strongly support Dr. Robbins's proposal."

The Chancellor nodded at Billingsley. The latter, easily the youngest person at the table, adjusted his bow tie and horn-rimmed glasses, and ran a hand through short greasy hair. "I'm ambivalent. If Howie's plan works, I can think of projects I'd like to do, too. Like go to Earth-Two and tell the Big Bopper and his pals to not get on that plane."

The big what? Robbins thought.

"But Toni"—he nodded at Brentano—"is afraid we're not smart enough to know what will happen if we change Earth-Two's past, and that we might screw things up. Based on the kind of literature I know best, I have to agree with her that violating the Prime Directive wouldn't be a good idea. We shouldn't risk turning the people there, or maybe even us, into lizards."

Into what? Robbins found Billingsley's sophomoric obsession with "popular culture" of the last century very irritating. While the other humanities sections were recovering things of real cultural value on TCE, the sociology section Billingsley headed wasted its time scanning old "films" and recording episodes of twentieth-century radio and television programs that were probably better left lost. Billingsley defended the "scholarly" nature of these projects, saying, "The best way to understand a society is to see what its people enjoy, what they consider entertainment." But, Robbins suspected, the real reason the powers-that-be tolerated it was that those samples of pre-Digital Revolution "entertainment" were wildly popular on the public Nets—and the Institute collected a royalty each time one was downloaded. Besides, how much scholarship could you expect from someone whose doctoral thesis was entitled, "The Role of the Tropicana Club as a Microcosm of Early 1950s American Society in 'I Love Lucy'"?

And Robbins hated it when Billingsley used terms he didn't understand. He made a mental note to run a Net search on what "Prime Directive" referred to.

The Chancellor said, "Dr. Velikovsky?"

Robbins tensed. Velikovsky, of the history section, was the pivotal vote.

The latter began, "This is not an easy decision. Even a tiny, critical change in TCE's past could have great, perhaps very negative repercussions for its later history. I can't be certain whether saving this particular individual would be such a change. Those 'extra' ten years Dr. Harrison referred to were relatively quiet, politically speaking, in his own country—though not elsewhere in Europe. While the subject himself was something of a political revolutionary, it's difficult to see how he could affect the course of the various revolutions that occurred in Europe in 1830 and 1831. Conversely, if he were to live to 1848 or 1849, when even more critical events occurred—well, that would be even harder to predict. In that case, I would have to vote 'no' to Dr. Robbins's proposal.

"However, since Dr. Harrison is

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convinced he'll die no later than the 1830s, at this time I'm inclined to favor Dr. Robbins's proposal."

The Chancellor said, "Any other comments?"

Brentano again. "I'd like to remind everyone that the decision we make today might, as Dr. Robbins said, 'enrich' both our world and TCE—or it could destroy them. Even if we do have much to gain, is it worth such a terrible risk?"

Robbins said, "Although I appreciate Dr. Brentano's concerns, as I said before, and as Drs. Everett and Velikovsky have confirmed, the risks seem minimal. And oh, how much we and TCE stand to gain! Genius, whether it is in music or some other field, is a rare and precious thing. Those individuals blessed with such great powers of creativity and original thought are given to the rest of humanity only briefly, but what they do far outlasts their own lifetime. It is tragic when one of them is taken away from us prematurely by an accident of nature, leaving his work undone—the masterpieces he might have created, unfinished, or stillborn. We have the means to correct one of those tragedies. I believe we should do it."

"Any more comments? No?" The Chancellor continued, "Is there a second for Dr. Robbins's proposal?"

"Seconded!" Lytton and Shimura spoke simultaneously.

"Those in favor of Dr. Robbins's proposal, raise your hands."

Robbins's own arm went up immediately, followed by those of Lytton and Shimura. After some hesitation, Velikovsky's joined them.

"Opposed?"

Brentano and Billingsley.

"Let the record show that the humanities committee has voted four to two in favor of Dr. Robbins's proposal."

For the first time since the meeting started, Robbins relaxed. He'd won! The hardest part—getting the executive, then the science, and now the humanities committee to approve his proposal—was over. The rest should be simple—just go to TCE and do it. Robbins could barely contain his excitement.

Soon he would travel to Vienna in 1825 and save the life of Ludwig van Beethoven.

"Congratulations."

Robbins sighed. He'd known this was coming.

Antonia had asked to come to his apartment in the staff quarters that evening. "Just to talk," she'd said. But he knew what she wanted to talk about.

"Thank you," he replied.

"When are you going?"

"Tomorrow morning."

"I don't suppose there's any way I can talk you out of it?"

"No, there isn't."

The muted lights in the apartment cast a lustrous sheen on Antonia's long brown hair. Though they were both toward the middle of middle-age, unlike his own, her hair was just starting to show a little gray. And as for the rest of her—he knew all too well how heartachingly beautiful she was.

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He and Antonia Brentano had been among the first of the humanities staff to come to the Institute. Though different in many ways, they found they both shared a passion for classical music. Acquaintance had turned to friendship, and then they'd discovered something else they shared—loneliness. Neither of them had ever been married, or had any close family. Immersed in his work for so many years, until he met her he hadn't noticed what was missing from his life.

In retrospect, it was natural that they'd drifted into a brief but intense love affair—and just as natural it should end. They'd soon realized they were both too dedicated to their work to have enough time and energy left for each other. Afterwards, they'd still maintained a cordial, platonic friendship. But now they might lose even that.

They sat on the couch together silently for a while, listening to the music. A large bust of Beethoven frowned at them from atop the Steinway that filled a good part of the living room. Pictures of Robbins's other favorite composers hung on the walls. The one of J. S. Bach seemed to be smiling in approval at the piece Robbins had selected—the master's "Concerto in F-sharp minor, for three violins and string orchestra." Absorbed in the first movement's intricate counterpoint, it took him a few seconds to realize Antonia was speaking.

"Why, Howard? Why do you have to do this?"

"It's just like I said at the meeting. I want to allow a genius whose life was cut tragically short to create new works for the benefit of all humanity."

"Oh, cut the melodrama! If you're really serious, you have the worse case of hubris I've ever seen. Is it an ego thing with you—a way to bask in Beethoven's reflected glory by being the instrument for his 'resurrection'? If that isn't 'playing God,' I don't know what is!"

"But I really mean it! There's nothing selfish in this!"

The expression on Antonia's face told him what she thought of that.

"Listen," he began, "over the last four years my staff and I have traveled to TCE and recovered thousands of scores by the great composers that were lost for one reason or another centuries ago. We knew about some of them from surviving fragments or the incipits—the first few measures of the main theme—in catalogs of their works that the composer or a near-contemporary compiled."

"Like, the Köchel catalog for Mozart's works?"

"Exactly. Since we knew about when those 'lost' works were composed, we've been able to go back and retrieve them. When we did that, however, we also found many 'new' works that nobody knew anything about!"

The concerto had entered its heartrendingly lyrical slow movement, a Largo in A major. "The piece by Bach we're listening to now is one of them—unknown, forgotten for over three centuries until I went to Cöthen in 1722 and scanned a copy of the score. By going to TCE we've managed to nearly double the amount of his music we had before the Insti-

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tute was formed!"

"I don't understand. How did all that music get lost?"

"Several reasons. After Beethoven's time, we already had nearly all of the music the 'major' composers wrote. Unless they destroyed what they considered 'inferior' works, like Chopin. Or, if they were very careless with the manuscripts." Robbins smiled to himself. After rummaging through Schubert's closet at various times during the mid-1820s, he'd finally found the completed third and fourth movements of the composer's B minor symphony—the one that *used* to be known as the "Unfinished."

"Before Beethoven's time, however, very little of a composer's music was published. Mostly, the scores of their works existed only in a small number of hand-written copies, all of which could easily be lost by accident or neglect. Plus, the major composers before Beethoven were very prolific. Bach himself wrote nearly 2,000 works. They wrote so much music it was hard even for them to preserve or keep track of everything they wrote!

"But now my staff and I have become victims of our own success. We've managed to recover just about everything those composers wrote. At the rate we're going, soon we may not need to go to TCE anymore."

"So that's it!" The anger was back in Antonia's eyes. "This proposal is just your way to justify staying at the Institute!"

The concerto began its fiery third movement, back in the tonic minor.

"No, that's not it at all! Till now, all we've been doing is acting like scavengers. We've been retrieving these lost works for ourselves, *we* now have them—but the 'First Law of Contact' forbids us to give them back to the people of TCE! What I'm going to do will benefit both us and them!

"Lytton understands. Think of all the poets and writers who died 'before their time'! Like Percy Shelley—drowned at age twenty-nine in a stupid boating accident. Or John Keats, who died at age twenty-six from tuberculosis, something that Harrison could prevent easily. Edward says the first thing he'd do is give Charles Dickens a few more years of life, so he can finish *The Mystery of Edwin Drood*. The point is, if any of them lived longer on TCE, anything new they created would become part of both our cultural heritage—and theirs!

"And Shimura—his list has van Gogh, and—."

"All right, all right! I don't disagree with you about the possible benefits, just the risks." She glanced at the brooding plaster figure on the piano. "But why Beethoven? Why not someone who died younger—like Mozart? He'd probably live even longer and write more music than Ludwig."

"But that might backfire! If Beethoven lived too much longer, his career would overlap those of Chopin, Schumann, and other composers active in the late 1830s and '40s. If he was alive and writing constantly greater masterpieces himself then, they might feel discouraged, unequal to the task of reaching his standard of excellence, and not write much themselves! Although we'd still have them, TCE could be deprived of their greatest works. The same thing could happen

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if we saved Mozart, only worse—because Beethoven himself would be one of the composers who might be 'discouraged'!

"But remember, Harrison said Beethoven won't live much longer even if I do temporarily 'save' him. So, both we and TCE should get the best of both worlds—a few more works by one of the greatest composers of all time, and no bad effects on his contemporaries. Plus, we'll prove we can do something good for the people of TCE, too."

"But that's the real question, isn't it? How do we know we'll do something good for them?" Antonia took a piece of paper from her purse. "Billingsley asked me to give you this. He says you haven't answered his messages, and he's been too busy making trips to TCE to catch you in person." She smiled grimly. "He said he wants to salvage as much 'pop-culture' as he can from the twentieth century before you 'screw things up and wipe it out.'"

How typical, Robbins thought. He took the note and stuck it in his pocket.

The Bach concerto sounded its final cadence. In the silence that followed, Antonia sighed. "It's getting late, and I have to leave."

Robbins walked her to the door. In the open doorway she said, "I don't care at all for what you're going to do. Even if the chance of something bad happening is small, it's still too much." She hesitated. "But I do care about you. Whatever happens, take care of yourself."

She gave him a brief hug, brushed her lips chastely across his cheek, and was gone.

The scent of her perfume lingered in the empty room. Sitting down at the piano, he played "Für Elise," mentally changing the title to "Für Antonia." "You don't mind, do you?" he asked the bust of Beethoven. The latter scowled back at him.

Then he remembered Billingsley's note. It read, "Dear Howie, Please read these stories. They might make you change your mind about changing history on Earth-Two."

There was a list of ten titles and authors. Well, why not?

"Computer?"

"Yes?" a warm contralto voice answered from the walls.

Robbins looked at the first title on the list. "Access story, 'A Sound of Thunder.'"

"Category, science fiction?"

Robbins frowned. "I suppose so."

"Author, Bradbury, Ray?"

He checked the note. "Yes."

"Would you like it read to you, or a printout?"

"Printout."

Robbins watched as sheets of paper spat out of a slot in the nearby wall into the wire basket attached beneath it. When the printout stopped, he read the first few pages—then threw the papers down in disgust. Hunting dinosaurs—how ridiculous!

He should have known better. Once he'd asked Billingsley why he always used the term "Earth-Two" instead of the standard "Transcosmic Earth." The latter had replied very seriously that it referred to a series of "graphic novels" written in the last half of the twentieth century. He'd given Robbins a list of titles and au-

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thors then, too.

Intrigued in spite of himself (What was so "graphic" about them? And what did those strange titles like *Flash of Two Worlds* refer to?), he'd asked for printouts from the Net then, too. His surprise at receiving pages of small, crudely colored and lettered pictures turned to anger when, at his query, the computer said those so-called "graphic novels" were more commonly referred to as "comic books." It was so—typical of Billingsley, quoting from simple-minded stories written for children!

Robbins read more titles on the note. *Timescape. By His Bootstraps. The Men Who Murdered Mohammed. Appointment in Berlin.* Then he crumpled it and tossed it on the floor. Probably more of the same. Not worth wasting his time over.

Fingers poised over the keyboard, he hesitated. Right now he didn't feel in a heaven-storming, Beethovean mood. Something lighter—like Chopin. Playing through several of the master's études from Opus 25, some of his tension drained away. As the last fluttering strains of the delicate étude no. 9 in G-flat major, the one nicknamed "The Butterfly," faded away in the quiet room, he addressed the bust on the piano again. "Do you think I'm doing the right thing?"

Beethoven scowled at him even more disapprovingly.

Development

"Look's good from this side, Dr. Robbins."

Robbins examined himself in the changing room's full-length mirror, and nodded in agreement. The "Night Operations Camouflage" suit that Miles, the Portal Technician, had just helped him put on resembled a deep-black wet suit, covering him from shoulders to ankles with an opening for his head. A wand-like digital scanner hung from a black belt around his waist.

Miles continued, "I calibrated and focused the portal just before I came here. You can translocate as soon as you finish getting dressed."

Robbins sat down on a bench and tugged a pair of black boots on. "We'll have to wait for Harrison. He's bringing the vaccine I'm going to use."

Miles frowned. "Dr. Harrison's bringing it?"

"That's what he told me. Why do you ask?"

"Because just before I left the Portal Room to help you, Dr. Ertmann came in. I assumed she had it."

"Well, as long as one of them brings it." He stood up, and Miles handed him a black hood. It covered his entire head except for small circles at his eyes and slits for his mouth and nostrils. Robbins pressed the edges of the hood and suit together. Their magnetic strips made a tight seal.

Miles handed him a pair of black goggles. Securing them with a strap behind his head, Robbins turned them on. A multicolored display appeared at the top of the left lens. "Fully charged, diagnostics check out," Robbins read. "Lights off."

In the darkened room the goggles switched to "NightVision" mode. Though it was like looking through green-colored lenses, everything in

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the room could be seen as clearly as in normal light.

"Lights on." Robbins checked himself in the mirror again, and smiled. Billingsley called the NOC suit a "cat burglar outfit"—not a bad description for what it was designed to do.

To avoid contact with the people of TCE as much as possible, most of the work done there consisted of searching through rooms at night for manuscripts or other documents. Should a "native" happen to come into one of those dark rooms unexpectedly, the NOC suit was supposed to keep the wearer undetected long enough to hide or escape.

"Don't forget this."

Robbins took the bracelet from Miles and snapped it around his left wrist. No, he didn't want to forget that. Without it, he couldn't activate the portal from TCE and return to their Earth.

They walked back through the short corridor to the Portal Room.

Harrison was there, bending over a young woman wearing a white lab coat who was slumped forward in a chair near the main control console. Robbins didn't recognize her. She seemed to be in her early thirties, with cascading red hair and pale skin. Sobbing violently, she buried her face in her hands.

Harrison looked up at Miles and him, obviously worried. "Do either of you know what's wrong with Dr. Ertmann?"

Miles shrugged. "Beats me. She was fine when I left her about ten minutes ago."

Harrison bent down again, close to the woman's ear. "Dorothy, what's the matter? Are you sick? Do you want me to get some help?"

Slowly Ertmann looked up at Harrison. Her face was drawn, her eyes red and moist. When she wasn't crying, Robbins thought, she was probably quite pretty. "I'm so sorry," she said, "I should have known better than to—." She stopped suddenly, staring at Robbins. "Who is he?" she demanded.

"That's Dr. Robbins." Harrison said. He frowned at Robbins's black, hooded form. "That is you, isn't it?"

Robbins nodded.

"Dr. Harrison, do you mind if I leave now?" Ertmann pleaded. "I'm sure he"—she pointed at Robbins—"will tell you what happened!"

"Do you feel up to walking? I can get a wheelchair—."

"No, that's all right." With an effort Ertmann lifted herself out of the chair and headed toward the exit. "I just need to go to my room and . . . lie down for a while."

"Well, if you're sure you're up to it—."

"I'm sure. Please, I just need to be alone!"

After she left, Miles said, "Doc, what was that all about?"

Harrison shrugged. "I don't know. I arrived just before both of you came in, and found her sitting there, crying!" He paused. "Dorothy has always been—sensitive. When things don't go right she can get very flustered. But I've never seen her this upset before."

Shaking his head, Harrison took a small white box from the floor and opened it. "I'll go check on her after

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we finish here." He extracted a device resembling an automatic pistol, and a small bottle filled with clear fluid. Flipping its metal tab off, with a twisting motion he inserted the top of the bottle into a round slot on the bottom of the body of the device, then gave it to Robbins. "Any questions?"

"No." Robbins hefted the transcutaneous injector in his hand. Yesterday Harrison had demonstrated how easy it was to operate by using it on him. "Press the tip of the injector firmly against the upper arm like this, release the safety catch, and pull the trigger." Robbins had felt only a slight tingle as the sterile water Harrison had loaded it with passed through his skin, leaving a small red spot that quickly disappeared.

Robbins nodded to Miles. "Ready when you are." The latter moved toward the control console, pausing to pick up several objects off the floor and replace them on a nearby shelf. Glancing over the displays on the console, he said, "The portal is still stable and active. Local time on TCE is now . . . 1:10 A.M., November 17, 1825."

Nervously, Robbins went to the entrance of the portal. It was a large cylinder, about six meters long and laid on its side. It was flattened a little where it touched the platform, and its entrance was about three meters in diameter. When the portal was active, like now, at the near end of the cylinder was pure blackness. From past experience Robbins knew better than to stare into that utter emptiness. It made him dizzy, as if he were looking down over the edge of a high cliff into a bottomless chasm.

Here goes. Walking into the portal wasn't painful. It felt like his whole body had been turned into a mildly vibrating tuning fork, resonating at middle C. Miles had told him the sensation was due to his passing through "low-level phase-inverted force fields" used to keep air molecules and microorganisms from passing from Earth to TCE. Those fields did, however, let "slow-moving, macroscopic objects" like him through. And, the portal was basically a one-way path from Earth to TCE. With a few exceptions, like the oxygen bound in his blood when he breathed there, no matter or energy originating on TCE could come into their world—.

Suddenly his thoughts were interrupted—he was there. His first breath brought a multitude of unpleasant smells. The NV goggles activated automatically in the dark room.

He was in the kitchen of Beethoven's quarters. A fireplace filled with musty ashes was set into one wall. The room had several tables and open shelves, with plates, bowls, and utensils on them. In one corner stood a dusty, dilapidated pianoforte. Robbins smiled slightly. It was ironic that the composer, who had started out as a piano prodigy and contributed so much to the literature for the instrument, had become so indifferent to it in his final years. After finishing his last sonata and the Diabelli variations a few years before, he wrote no other major works for it. Maybe it was because he couldn't hear and enjoy his own playing, or was too preoccupied with major projects like the *Missa Solemnis*

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or the Ninth Symphony. Whatever the reason, it was sad to see his piano so badly neglected. Given extra years of life, maybe he would write for it again.

He didn't notice the knife lying on the floor until he accidentally kicked it. It skidded across the floor and rattled into a corner. Robbins froze instantly, straining to hear anyone talking or moving, alerted by the noise. But everything stayed silent.

Slowly, he entered the main living area, carefully avoiding bumping into the small writing desks and chairs scattered around it. He was tempted to examine the partially-notated sheets of staff paper on the desks, but refrained. First things first.

The door to Beethoven's bedroom was open. Moving even more cautiously, he entered it.

The composer was lying on his right side in a small wooden bed, snoring quietly. A thin blanket covered him up to the waist. He wore a plain night shirt that was torn in several places. A fringe of unruly hair peeked out from beneath his night cap.

Robbins contemplated the sleeping figure. Here, he knew, was one of the greatest musical geniuses of all time, one who set a standard of excellence that no later composer had ever surpassed. Superficially, though, all he saw was a paunchy man, prematurely old at fifty-four, with a homely, pockmarked face.

With a grunt the man on the bed strained and farted loudly. Robbins froze again, expecting him to wake up any second. Instead, a smile came to the man's face. He resumed his melodious snoring.

Robbins looked carefully for a place to inject the vaccine. Fortunately, there was a large tear in the night shirt over the upper left arm. Cautiously, he raised the triangular flap of cloth upward, exposing the skin beneath. He released the safety on the injector and pressed it down—.

There was a faint click as the injector fired. Robbins jumped back, watching to see what the composer would do. But he only snorted, and kept on sleeping.

Slowly, Robbins retraced his steps back out to the main room. There he succumbed to temptation and ran his scanner over the sheets of music he'd seen before. Back in the kitchen again, he checked the chronometer display in his NV goggles. He had been on TCE ten minutes—and was right on schedule. Since an equal amount of time had passed for Harrison and Miles on the other end, they would be expecting him to return about now.

The next step was to reactivate the portal, return temporarily to Earth, and then translocate back to see if the composer was still alive in Vienna on March 27, 1827—the day after he was "supposed" to die. Excitedly, he pressed a stud on the retrieval bracelet. The air shimmered in front of him, like heat waves above a hot street, indicating where his end of the portal was located. He stepped into the shimmer . . . .

Robbins took another peek over the rim of the crater. The Cossacks

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were still coming slowly toward him—about seventy meters away. Ducking his head back down, his mouth slid wetly across the muddy side of the crater. A few measures from On the Beautiful Blue Danube *lilted through his brain before he could shut it off. He was going to have to make a run for it and take his chances. Not a great choice, but better than just staying there in the mud and dying on his belly—.*

Suddenly he heard the Cossacks yell excitedly. Glancing up again, he saw them pointing toward the barrel of a rifle poking through the second-floor window of a building on his left. There was a sharp crack! *and the tall black hat of one of the Cossacks went flying off.*

Immediately two of them dismounted and ran into the building. The other pair quickly brought themselves and all of their horses close to the front of the building, out of range of the rifle. Robbins braced himself to make a run for the alley containing the portal while the Cossacks were distracted, but thought better of it. The two by the building were directly across the street from the entrance to the alley. They would probably see him before he reached it—and he doubted they were in any mood to take a prisoner.

From the building Robbins heard men shouting—and then a woman scream, "No!" A moment later the two Cossacks emerged dragging a young man, and a woman Robbins assumed was his wife. She was in her late teens, with auburn hair, and obviously pregnant. She pleaded with their captors not to hurt her husband Josef, her baby, or her. The young man just shouted curses at them.

The Cossacks laughed harshly. One of the pair still on horseback dismounted and said something to the couple in broken German. Robbins couldn't make out all of it, but what he did understand made him feel sick. Then the Cossack nodded to the one holding the woman. The latter pulled her down on her back to the dirty street, pinning her arms and grinning wolfishly in patient anticipation as she struggled futilely. The other one knelt beside her, and roughly pulled and ripped her long skirt high above her waist.

Paralyzed with horror, Robbins stared open-mouthed at the scene playing out in front of him. The bare thrashing legs and waist of the woman. Glimpses of her protruding, pregnant abdomen. The husband, locked in a tight bear hug by the Cossack standing behind him, no longer cursing but pleading with them in the names of Jesus and the Blessed Virgin. The other Cossack, standing with his back to Robbins just in front of the young woman's feet, slowly, methodically, pulling down his pants.

Robbins clenched his fists, reflexively praying to God himself to tell him what he could do to help her. He wasn't a fighter, he didn't have any kind of weapon. If he tried to stop them they'd just take a minute to kill him, and then get on with it.

What could he possibly do to change things—.

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* * *

"Nothing changed."

Robbins slumped down into the cushioned chair in the Chancellor's office. He was still dressed in a long coat, coarse woolen trousers, white shirt and vest—typical dress for a Viennese bourgeois, c. 1827.

The Chancellor sat behind her desk, a look of concern on her face. Everett sat in a chair next to him.

"I translocated to Vienna again a little after dawn on March 27, 1827. After I came out of the alley containing the portal, I walked several blocks and found a street vendor selling newspapers." Robbins paused dejectedly. "On the front page it said, 'Yesterday afternoon, our beloved Herr Beethoven passed on to his reward.' Then I returned to Earth, and translocated back to Vienna on the afternoon of March 29, 1827." Briefly he described blending in with a large crowd of mourners as the composer's funeral procession wended its way through the streets of Vienna.

He looked at Everett. "Why didn't it work?"

The latter shook her head. "I don't know. From the standpoint of transcosmological physics, there are two possibilities. One is that I've been wrong all these years about the 'pliable' nature of TCE's history. The other is that, by injecting Beethoven with the vaccine, you may actually have prolonged his life—but in a new 'subbranch' universe you created by that intervention. The problem is, if that were so, we might be able to translocate only into the 'original' Universe where he died on the same day as in our history. Thus, from our point of view, we will seem to have done nothing."

So that's that. Robbins loosened the collar of his starched linen shirt and sighed. So close—.

"But, there is another possibility."

He looked at Everett again.

"The reason may not be transcosmological, but medical. Maybe Harrison's opinion that Beethoven died of hepatitis is wrong. Maybe you didn't give the vaccine properly."

Robbins frowned. Well, he thought he had—.

"Also, Harrison said the success rate with the vaccine was 95 percent. That means it would fail one time out of twenty. Maybe we've just been unlucky."

Robbins looked thankfully at Everett, feeling like a condemned prisoner who had received, if not a full pardon, at least a stay of execution.

The Chancellor asked, "What do you propose we do?"

Everett shrugged. "Harrison's the expert on the medical possibilities. I suggest we discuss them with him." She paused. "Speaking of Harrison, wasn't he supposed to be at this meeting too?"

Just then the office door opened and Harrison walked unsteadily into the room. He collapsed into an empty chair and wiped a pale forehead with his palm. Right now, Robbins thought, he looked more like a patient than a physician.

"Sorry I'm late," he mumbled. "I—Dr. Ertmann is dead."

The Chancellor frowned. "Who?"

"Dorothy Ertmann. She's been with

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me for five years."

"I'm sorry to hear this." The Chancellor looked truly concerned. "How did it happen?"

"She killed herself." Harrison massaged his eyes. "At least she knew what to inject herself with to make it quick. Relatively painless."

Everett said, "Do you know why she did it?"

"She left a note. But it wasn't very specific. Something about her being so sorry that she'd betrayed the Institute and all of us. Especially me." Harrison sighed. "Her closest relative is a younger sister in Des Moines. I'll have to call her."

The Chancellor said, "I know how upset you must be, and we won't keep you here any longer than necessary. Before you arrived, we were discussing why Dr. Robbins's project failed."

Harrison listened patiently as Everett repeated *sotto voce* what she'd told them earlier. He said, "Based on our tests, I'm certain our diagnosis of the cause of Beethoven's death is correct. And I taught Dr. Robbins to use the injector myself. It's so simple to use, it's virtually idiot-proof." He glanced at Robbins. "Sorry, that didn't come out right."

"No offense taken."

Harrison continued, "Also, the vaccine won't work if the recipient can't generate a good immune response, or if the infection is too severe."

Everett said, "Could the dose itself have been defective in some way?"

Harrison shook his head. "No. I tested it myself shortly before giving it to Dr. Robbins. It never left my possession until I gave it to him."

"Then what do you suggest, Dr. Harrison?" the Chancellor asked.

Harrison shrugged. "Dr. Robbins should go back again, and inject Beethoven with nanoscrubbers. Barring previous treatment with a specific blocking agent, they're essentially fail-safe."

Everett frowned pensively at Harrison. "While I was listening to you I thought of another possibility." She paused. "Deliberate sabotage."

Harrison sat straight up in his chair.

"What are you suggesting?"

"It strikes me that both the transcosmological and medical reasons for this failure are so remote that we can't rule out the human factor."

"I told you, I tested the vaccine myself and kept it with me until—."

"I'm not accusing you of anything. Or Dr. Robbins either."

Me? Robbins thought. *This is my project. How could she think—.* He paused. *Unless she thinks I'm so diabolically clever I proposed it just to sabotage it, so no one else would try to change TCE's past.* Robbins felt a trickle of sweat form under his armpits. *I know I didn't sabotage it. But how can I prove it to them?*

Everett continued, "Do you know anyone else who had both the technical knowledge and opportunity to sabotage the project?"

Harrison frowned. "Well, I suppose—."

"Dr. Ertmann."

They all looked at Robbins.

"Remember, Dr. Harrison? She was in the Portal Room just before I translocated. Could she have done something?"

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Harrison glared at him in a way unbecoming someone dedicated to the saving of lives.

"Madame Chancellor," he said, "I find Dr. Robbins's insinuation in very poor taste, considering the person in question has just died under tragic circumstances and cannot defend herself."

"We understand, Dr. Harrison," Everett said. "However, try to put your personal feelings aside, and give us an honest answer."

Harrison's shoulders sagged. "Dr. Ertmann was very—idealistic. She was one of the most caring and dedicated physicians I have ever worked with."

He paused. "However, I must say this too. When Dorothy went back and obtained those specimens from Beethoven, she was under the impression it was a standard pathology project to discover his cause of death—the kind she and I have done on so many other historical figures before. After Dr. Robbins's project was approved, I"—he hesitated—"told her what its real purpose was. And yes, I know that information was only supposed to be given on a strict 'need to know' basis. But I believed that, considering the dangerous work she'd done, she had the moral, if not technically the legal right to know."

Everett said, "And how did she react when you told her?"

"She became very angry. She cited the potential risks of erasing our own world, or of causing some unforeseen catastrophe on TCE—much like Dr. Brentano did at our recent meeting. She even accused me of lying to her, and betraying her."

The Chancellor asked, "But—what does this all mean?"

"It means," Everett answered, "that we try again. But this time, it's going to be a little more complicated. And,"—she looked at Robbins—"a lot more dangerous."

After putting on his NOC suit, Robbins re-entered the Portal Room. Miles was talking to Everett and Harrison. "—Now that you mention it, I did pick up a pair of NV goggles and a retrieval bracelet off the floor after Dr. Robbins and I came back into the Portal Room."

Everett looked at Robbins. "The technician says Dr. Ertmann was left unattended at the active portal for ten minutes. So she had time to enter TCE, and do something to sabotage your attempt to vaccinate Beethoven. Harrison says she probably injected him with a blocking agent which would prevent him from responding to the vaccine you gave, or any nanoscrubbers we might inject later."

Harrison nodded.

Robbins said, "Tell me again. What exactly am I supposed to do?"

"The technician has set the coordinates to translocate you to Beethoven's apartment about five minutes before we believe Dr. Ertmann arrived. What you need to do, is stop her. Confront her when she arrives. Convince her to return without doing what she came to do." A grim smile formed on Everett's lips. "Be creative."

Robbins replied, "But how is that going to change anything? You're saying that if I stop Dr. Ertmann, the vac-

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cine I injected should work then, and Beethoven will live longer. But, I know he didn't live longer, because when I went to TCE the day after he was 'supposed' to die, he was dead. Therefore, I won't succeed, I can't succeed in stopping her! Do you understand what I'm trying to say?" Robbins frowned. He wasn't sure *he* understood what he was trying to say. "It sounds like I'm supposed to change what's already happened. And I remember you said it's impossible to change our past."

"No," Everett replied patiently, "we can't travel back along the timeline of our own branch Universe and change its past. But, as I said at your meeting, we can change the 'past' of TCE without running into the kind of causality problems you're trying to describe. In other words, from our 'past' and 'present' perspective, Dr. Ertmann did succeed in preventing the vaccine from working and prolonging Beethoven's life. However, if you go back 'now' and stop her, from our 'future' point of view—which will become the 'present' when you return through the portal after stopping her—at that time, from our perspective, she will have failed, and the vaccine you gave will work. Is that clear?"

Robbins knew she couldn't see his face through the black hood of the NOC suit, but she must have guessed how bewildered it looked.

Everett said sympathetically, "Even if you don't understand, just take my word. If you do what I tell you, it will work." Then a real smile flickered on her lips. "Trust me, I'm a physicist!"

Robbins and the other two men blinked. *Now's the time she decides to show she has a sense of humor,* he thought.

Recovering first, Miles said, "The portal is stable and active, Dr. Everett."

The latter said, "Good luck, Dr. Robbins." *Sounds like I'll need it.* He walked to the portal entrance—.

"One more thing." Caught with one leg in the air, Robbins teetered on the threshold of the portal before righting himself.

The grim smile was back on Everett's lips. "Make sure you stay on TCE no more than fifteen minutes. Otherwise you might—literally—run into your 'past' self coming through to inject the vaccine. I'm not sure what would happen if that occurred, but some of the possibilities are very—unpleasant."

As if I didn't have enough to worry about already.

At least the translocation went smoothly—no rude surprises so far. The kitchen in the composer's apartment was almost exactly as he remembered it. His NV goggles guided him back to the main studio room. He positioned himself in the corner of the room farthest from the bedroom door—and waited.

After what seemed like an eternity, he heard a faint rustle from the kitchen. A few seconds later, *she* came through the open doorway. Ertmann was dressed just as he'd last seen her in the Portal Room. She was wearing the NV goggles and bracelet Miles had mentioned. In her left hand she held an injector like the one he'd

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used to inject the vaccine—or was that "going to use"? He let her get half way to the bedroom door before he whispered, "Stop."

She froze like a statue. While the rest of her remained immobile her head swiveled slowly towards the direction of his voice.

"I know what you're planning to do, and I can't let you do it." Robbins hoped he sounded menacing.

"Dr. Harrison sent you, didn't he," she whispered back.

"Yes."

Shoulders slumped in resignation, she placed the injector in a pocket on the side of her lab coat. "I should have known it wouldn't work."

"Now we're going to go back to the kitchen together, activate the portal, and leave. Understood?"

The expression on her face was so forlorn he had to suppress an urge to go over, give her a hug, and say, "There, there, it's all right."

Ertmann shrugged. "Why not?"

Moving quietly to her side, Robbins steered her back toward the kitchen. As they entered it he started to activate the retrieval bracelet on his wrist—and then she broke away from him and screamed, "No!"

Startled, Robbins froze. What if she'd just woken Beethoven up—.

"What you and the others are planning to do is wrong!" she shouted. "It could destroy our world, and this one! Billions of living, breathing human beings—on our Earth, this one, all of us—might be snuffed out like we'd never existed, or maybe suffer something worse than we can possibly imagine! I can't let you do it!"

She snatched a wicked-looking, vaguely familiar knife from a nearby table and pointed it at him.

Robbins stared at her. What was he supposed to do now? He was taller than she was, probably stronger. But he was no fighter, she was about fifteen years younger than him—and she had a knife.

"Don't be foolish," he said. "It's over. Just what do you think you're going to do with that knife?" Remembering too late that she was probably an expert at surgery, he hoped she'd take it as a purely rhetorical question. "We're on to your plan, and you can't fight all of us!" *Of course,* he added to himself, *the rest of "us" don't happen to be here right now—.*

The knife in Ertmann's hand drifted slowly downward. "You're right," she whispered. "I can't fight all of you."

You've got her on the ropes, now finish her off! "Harrison took you into his confidence. He *trusted* you—and you betrayed him! You betrayed all of us at the Institute—but most of all you betrayed him. He's been like a father to you all these years, and you still betrayed him!" He wasn't sure if the "father" part was true, but it sounded good.

The knife clattered to the floor. Robbins glanced over his shoulder, expecting to hear curses in German and see an irate composer storm out of the bedroom to confront the prowlers in his home.

"You're right," Ertmann repeated. The NV goggles covered her eyes so he couldn't see the tears, but she was sobbing: "What do you want me to do?"

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"Activate the portal and leave—now!"

It was hard to act so cruelly. He had to suppress another urge to give her a comforting hug. Quietly, she fumbled with the bracelet on her wrist. The portal snapped to shimmering life—and then she was gone.

Robbins exhaled slowly. *Didn't know you had it in you.*

Then he tensed again. Just because Beethoven hadn't made a dramatic entrance into the kitchen didn't mean he wasn't stumbling around in his bedroom trying to light a candle to see who was making the commotion. Cautiously, Robbins walked to the bedroom, and peeked in.

The great man was snoring heavily, lying in the same position Robbins had seen (would see?) him in when he came with the vaccine. Robbins mentally kicked himself for forgetting something so basic. Ertmann could have shouted and made noise all night and it wouldn't have woken Beethoven up!

He went back to the kitchen. He wasn't sure how much time he had before "he" would come through from the other side. And he certainly didn't want to find out first-hand what kind of unpleasant things Everett was alluding to if he encountered his "earlier" self.

As Robbins started to activate the portal a sudden thought stopped him. When he re-emerged back on Earth, Ertmann would still be alive—wouldn't she? He'd assumed that, by going back into the "past" to confront her and change what she'd done, he'd also be preventing her from committing suicide. Now, trying to remember what Everett had said, he wasn't so sure. But you couldn't talk to a "dead" person like that—could you? Then he remembered what he'd told Ertmann, how she'd betrayed everyone, especially Harrison—and where he'd heard those words before. If she was still dead when he returned to Earth—.

Feeling sick, he activated the portal and stepped through.

"Well, was it worth it?"

Robbins smiled at her. "I think so."

He sat down next to Antonia on the couch in his apartment. The last ten days had been the most exhausting—and exhilarating—of his life. He'd made thirty-two trips to TCE since translocating a second time to Vienna on March 27, 1827—and this time finding the newspaper headline was about somebody named Metternich, and not Beethoven's death. Daylight trips to music shops, more nighttime excursions to the composer's home during his additional lifetime—. Beethoven's apartment now seemed as familiar to him as his own.

After the composer died in 1834, he and his staff made scouting excursions every one to two years to see what effect his "new" music had produced on other composers. So far the survey had reached 1847—and found no significant changes. Chopin, Schumann, Mendelssohn, Berlioz—the new masterpieces Beethoven created hadn't affected their music. Maybe it was because those final works were so distinctly in his own individual style—an apotheosis of everything he

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had previously written. A musical valedictory, rather than breaking new ground like the *Eroica*.

Antonia said, "When can we hear this wonderful music?"

"Soon." Late this afternoon his staff had finished downloading all the scores he'd scanned from the composer's manuscripts into the musicology section's own computer system. After assigning digitized instruments to each part, and adjusting the dynamics and tempos, they now had versions of the music ready for playback.

"I have to admit, I am curious. What did he write during those 'extra' years?"

"Mostly chamber music. The remaining movements of his string quintet in C major. Three string quartets. Two piano sonatas. Three trios for piano, violin, and cello." He paused. "And one work for orchestra."

Antonia arched her eyebrows.

"You and I will be the first people on our Earth to hear Beethoven's final symphony.

"The A minor."

"The Tenth."

Raising his arm as if holding a baton, he brought it down with a sudden down-beat. "Computer—begin!"

The slow introduction to the first movement began with a series of crashing dissonances by the full orchestra. Finally the clashing chords resolved themselves into a quiet, gentle theme in C major, introduced by a solo clarinet and supported by pizzicato strings. Gradually the melody was taken up by the rest of the orchestra, underwent a brief development—then suddenly disappeared in a dark descent into A minor as the main Allegro section began. A short exposition presented two tragic themes. ("Both," Robbins whispered, "are derived from ones in works by J. S. Bach. The 'Crucifixus' section of the Mass in B minor, and a cantata entitled 'Christ Lay in the Bonds of Death.'") The development section kept almost exclusively to minor keys, the sense of pain, foreboding, and heroic but futile struggle in the music becoming more and more intense. The recapitulation brought no relief, finally ending in a whisper of hopeless resignation in the tonic minor.

The Andante second movement was a set of alternating variations on two themes, one in F major and the other in C minor. (Robbins smiled at the quizzical look on Antonia's face. "Sound familiar, don't they? Both melodies are similar to ones in *Messiah*. The aria *He Was Despised,* and the chorus, 'Surely He Hath Borne Our Griefs.' Beethoven once said Handel was his favorite composer.") The movement's initial quiet, pastoral mood eventually gave way to darkness and despair in its last measures.

The third movement Scherzo was a Presto in C minor that sounded like a *danse macabre,* a hideous joke. ("The main theme is like the one Mozart used in the 'Dies Irae' section of his *Requiem*.) Each return of the prayer-like melody ("More Mozart—from the *Masonic Funeral Music*") in the A-flat major Trio sections was, just as a glimmer of hope seemed to appear, abruptly trampled by the reappearance of the dark theme of the main section.

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And then—the fourth and last movement, initially marked Moderato. It opened with the reappearance of the original gentle C major theme from the beginning of the symphony, played this time in A minor. The higher strings and woodwinds played it softly, tentatively. Just as it swelled into a tragic sigh a harsh new theme played fortissimo by the trombones and lower strings tried to overwhelm it. ("That new theme," Robbins whispered, "is a verbatim quote of music Beethoven's old teacher, Haydn, wrote to honor the emperor of his native Austria.") Despite this onslaught by the second subject, the primary theme returned again and again, each time more forcefully, until it and the *Emperor's Hymn* seemed locked in a titanic struggle full of clashing dissonances. Then, after a sudden and dazzling modulation to its original key of C major, with trumpets blaring and timpani thundering the primary theme overwhelmed the "imperial" one, shattering it into scattered notes and crushing it out of existence. Its true power and strength finally revealed, the full orchestra took up the melody in a coda of orgiastic celebration and joy that made the ending of Beethoven's preceding symphony seem tame and restrained by comparison. Finally, amid martial fanfares of barbaric intensity by the brass and percussion, the strings and woodwinds played the victorious C major theme in a massive contrapuntal *tour de force* that brought the symphony to a triumphant close.

They sat together in silence for a long time, the music echoing in their ears, and hearts.

Finally Antonia spoke. "You're right. It was worth it."

"Actually," Robbins said, "Beethoven started a new symphony, in C minor, in 1826. But it never got beyond some sketches. Then, in 1831, he started this work, and finished it early in 1834. He wrote in his diary he'd been inspired to write it by some recent events, like the Poles rising up and trying to free their country from Russian rule. And especially by a gift his nephew Karl gave him on his sixtieth birthday—a German translation of Shelley's *Prometheus Unbound.* He said the music depicts the triumphant struggle of the human spirit and Life against tyranny and Death—the ultimate victory of freedom over oppression. Like the Fifth Symphony, or the *Leonore* Overture No. 3, only more so.

"Interestingly enough, a few years after it was first performed, the primary theme from the fourth movement, the one that closes the symphony so dramatically, was used as the basis for a very popular patriotic song. Just about every music shop I've gone into on TCE from 1837 on had copies of it for sale. The last time I went to Vienna, in 1847, a crowd was even singing it at some kind of street rally."

The lyrics were by an obscure Hanoverian poet. In the original German, they were hardly great poetry. Lytton had written a version in English for him which was no better. Like the first verse—"Arise, ye German sons, unite! / No foe can stand before thy might! / The future now belongs to thee, / In union lies thy destiny!"

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"It's like the way new words were written about the same time to Haydn's *Kaiserhymne* too, praising Germany instead of the emperor of Austria. *Deutchland über alles,* which became the German national anthem."

"Did Beethoven get to hear the symphony before he died?"

"Well, he could never have 'heard' it. Towards the end of his life he was almost completely deaf. Remember the story, that when he conducted the first performance of the Ninth Symphony, someone had to turn him around to see the audience applauding? But if you mean, did he ever attend a performance—no. He died just before a set of concerts was going to start. It was first played a week after his funeral."

He smiled at the bust of Beethoven on the piano. The composer scowled angrily back at him.

Robbins frowned disappointedly. *I thought you'd like hearing your symphony!*

"What exactly did he die of, Howard?"

He blinked. "From injuries suffered in a tragic street accident." *Run over by a runaway wagon carrying offal.* Never heard it coming. TCE had lost the romanticized story of the composer leaping from his deathbed to shake his fist in defiance at the lightning-filled sky. But, he believed, it had gained far more.

Antonia looked dreamily ahead, the music still playing within her. "When are you going back?"

Tentatively, he draped his arm over her shoulder. "Tomorrow morning. We're right on schedule with our survey, up to 1847. Velikovsky says there were major political disturbances in Vienna in 1848 and 1849, so he told me to 'jump ahead' to 1852, when things should be safe."

She replied, "So you're free for the night." Antonia's eyes gazed deeply into his, a shy but gently inquisitive smile on her lips. He had last seen that look in her eyes far too long ago, and knew she wasn't planning to go back to her own apartment tonight.

Much later, with Antonia lying asleep in his arms, Robbins gazed contentedly up at the ceiling of his bedroom. Memories of the music, of Antonia's body moving rhythmically against his, wafted through his thoughts like a slowly-played fugue. It was moments like this that made Life worth living. Now, even if he were to die tomorrow, he would die happy.

But as he drifted off to sleep, memories he'd suppressed for the past ten days seeped back into his mind. Of Everett saying, "No, there was nothing you could have done to save her." Of Harrison, Ertmann's mentor, reassuring him, "No, it wasn't your fault. She did it to herself." Maybe they were sincere, maybe they were even right. But as hard as he tried, he couldn't rationalize it, or forgive himself. So young, so beautiful. . . . He'd wanted to hug her, comfort her—not kill her! Remembering those things, the exuberance he'd felt from listening to the Tenth Symphony, from making love with Antonia, faded and died.

His semi-conscious mind tried to

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block those memories by replacing them with music. But the melodies it played were from tragic symphonies. Unlike those of Beethoven, some symphonies in a minor key, like Tchaikovsky's B minor or Haydn's E minor, did not finish in a bright, triumphant major key, but maintained the darker minor tonality and a mood of *Sturm und Drang* tragedy and despair to the very end. Sometimes, in music as in the real world, Death did defeat Life.

As Antonia pressed warmly against him, sleep finally claimed him too. But he slept poorly. All through the night more music haunted his dreams. Motifs from Schumann's overture to *Manfred*, especially the one representing Astarte. And the second movement of Schubert's string quartet in D minor. The one subtitled, "Death and the Maiden."

Robbins frantically pounded the sides of the crater with his fists. There had to be something he could do to help her! The Cossack's pants were around his ankles now, his bare buttocks quivering as he laughed, relishing the woman's terror—in no hurry to turn the horror of anticipation into the greater one of reality. He raised himself higher over the rim of the crater, his eyes desperately scanning the ground for a rock, a stick, anything he could use to fight them, even if he died trying!

And then he saw it—a flash of metal against the waist of the fat dead man lying nearby. Tucked into his belt.

A pistol.

Suddenly he heard music again in his mind. The whole Tenth Symphony, compressed into an almost instantaneous burst of sound and power. The dramatic battle of the human spirit against evil and Death, always fighting back, never giving up no matter how much pain and suffering it had to endure, until finally winning its ultimate victory!

In an instant, like a Titan unchained, he raised himself up from the ground, ran toward the dead man, pulled the gun from his belt, and sprinted towards the group ahead. The tiny bit of his mind that remained rational tried to tell him that he'd never fired a gun, that he didn't even how many bullets it had, but he ignored it. He screamed in Russian, "Stop!"

The Cossacks stopped laughing, and looked at him.

Holding the pistol outstretched with both hands, Robbins stood just far enough away so he could cover all four of them. The music within him started to fade as the reality of the situation sank in.

"Let go of them, you bastards!" The gun swiveled from one to the other. For the first time Robbins got a good look at the weapon. It looked like the kind he'd seen in that violent, century-old "Western" Billingsley had shown him once. Remembering what the hero of that "movie," Shane, had done with his six-shooter, Robbins cocked the hammer of the gun with his thumb.

The Cossack directly in front of him slowly bent over, pulled his pants back up, and turned around.

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"Peace be with you, my friend," he said through broken yellow teeth. "The Czar has sent us to free you from your oppressors. Certainly not to harm you!" He gestured toward the woman on the ground. "There is enough here for us to share. Let us all pleasure ourselves, and be brothers."

Even from five meters away Robbins could smell how foul his breath was.

The Cossack bent down again and seemed to brush some mud off his boot, curling his hand. Straightening up, he began to walk slowly towards Robbins. "Let me shake your hand in friendship—."

"Stay back!"

The other man's face looked wounded. "Surely you would not shoot down an unarmed man, one who only wishes to be your friend, like a dog! Surely you, a man of the German people, who are known even in our land for their courtesy and gentleness, would not do such a thing!"

Something glinted in the hand the Cossack had used to clean his boot. As the Russian raised his arm back to throw the knife he'd taken from the scabbard hidden in his boot, Robbins's finger squeezed the trigger of the gun. The recoil staggered him. He recovered in time to see the other man and his knife begin a slow fall to the ground, the top of his head blown away in a scarlet shower of blood, bone, and brain.

The Cossack still on his horse tried to spur it at him. Two shots, and he too lay sprawled and bloody on the ground. The one pinning the woman down leapt up and pulled out his saber. It clattered to the street after a bullet tore through the center of his face.

The last one was still holding the woman's husband, using him as a shield. As the Cossack tried to pull out his saber the man twisted away from his captor. Robbins put a bullet into the Russian's belly.

The sound of the Cossacks' horses whinnying and striking their hooves hysterically against the cobblestones snapped Robbins back to reality. The young man was at his wife's side, brushing off the blood and gore that had splattered on her bare flesh. Gently pulling her skirt back down, he hugged and comforted the sobbing woman in his arms.

In a daze Robbins walked slowly toward each of the bodies in turn, careful not to step in the spreading red puddles on the street. He didn't need Harrison here to tell him they all looked very dead. The gun at his side dangled from his finger, then dropped to the ground.

"Will you be all right now?" he asked the man, who'd raised his wife to an unsteady standing position.

"Yes, if you help me," the man said, glancing toward the nearest horse.

Robbins helped him lift the woman onto its back, sidesaddle. Then the man led the horse down the street, avoiding the crater Robbins had just vacated. He watched the couple turn the corner at the other end of the street, and heard the woman shout over the distant rum-

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ble of artillery, "God bless you, and thank you!"

Then, trying not to look anymore at what was on the ground, Robbins walked slowly toward the entrance to the alley—and the portal home. So much for the "First Law of Contact," he thought darkly as he reached for the bracelet on his left wrist—.

Suddenly there was a sharp bang! *and a tearing pain ripped through his back under his right shoulder. Knocked down by the impact, he looked back toward the front of the alley and saw one of the Cossacks—it was the one he'd shot in the belly—lying on his side, pointing the smoking barrel of the gun at him. The Cossack grimaced, dropped the gun, and then lay still.*

His back burning like acid, Robbins stared in disbelief at the red stain slowly spreading on the front of his shirt. Somehow he managed to stand up and stagger farther into the alley, fighting the urge to faint. When he tried to raise his right arm more pain lanced through him, and it was getting hard to breathe. Swinging his left wrist over toward his right hand, his numb fingers fumbled with the retrieval bracelet.

Suddenly the air in front of him shimmered, and the welcoming darkness of the portal appeared. Gasping for breath, legs feeling like lead, he stumbled into it. Blackness surrounded him, a peaceful oblivion without beginning or end. . . .

Recapitulation

When he woke up the pain was gone, and he could breathe again. The room was bright and decorated in white. He was in a strange bed, in an unfamiliar place—.

"Don't try to get up, Howard."

He sank back into the sheets, and smiled thankfully.

Antonia sat by the edge of the hospital bed. "Dr. Harrison says the surgery went fine, and soon you'll be as good as new." Robbins saw the relief in her eyes as she kneaded his hand. Life is so short and uncertain, he thought. It was time to get his priorities right. Cut back on his work, convince Antonia to do the same—and find time to build a life together.

Suddenly he felt very tired. As much as his heart wanted to gaze into Antonia's eyes, the rest of him just wanted to sleep.

"You won't leave me, will you, Antonia?" he croaked.

"Never, Howard. I'll never leave you."

He drifted back to sleep, Schumann's *Träumerei* wafting through his mind.

But when he woke up, Antonia was gone.

The nurse who came in a few minutes later told him that he'd been in the institute's hospital over four days. Then Velikovsky walked in. The latter asked him to describe what had happened on that street in Vienna in late 1852. Though eager to listen to every detail of the incident, he brushed aside Robbins's queries about what it all meant with "It's still too early to tell."

After Velikovsky left, Robbins tried

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to think it through himself, but couldn't. As many times as he'd traveled to TCE, his knowledge of the non-musical history of the places he visited was too sketchy.

Harrison saw him the next morning. "Everything seems to be healing well." He paused. "Velikovsky asked me to tell you that there's going to be a special meeting of the humanities committee at 1600 hours. Medically speaking, it should be safe for you to attend."

"What's the meeting about? That—incident on TCE?"

Harrison hesitated. "Yes. Velikovsky and his people started investigating it right after you returned, and he's presenting their preliminary findings and suggestions to the executive committee this morning. He'll meet with the science committee at 1400 hours, and your committee after that." He looked at Robbins with an expression that resembled pity. "There are many rumors circulating as to what he will say."

"Such as?"

Harrison shook his head as he left. "I always try to deal with facts, not things that may or may not be true. Life is so much simpler that way."

A little before 1600, two nurses helped him get dressed and into a wheelchair. The orderly who scooted him through the underground tunnel to the institute's main building, got him to the meeting room just on time.

The others were already there. He took the last empty seat, between Billingsley and Antonia. She didn't respond to his greeting, but stared stonily ahead. Before he could speak again the Chancellor said, "Thank you all for coming here on such short notice. As you know, Dr. Robbins was seriously injured during his last translocation to TCE. We all wish him a speedy recovery."

Then Velikovsky spoke. "For the last five days my staff has been traveling to TCE investigating the historical anomaly experienced by Dr. Robbins. Many were given missions which would normally have been considered too dangerous. Some have actually been injured—several fatally. Through their dedicated efforts, we now know that Transcosmic Earth has suffered a major catastrophe."

Everyone in the room glanced at Robbins. *What happened? What did I do?*

Velikovsky continued, "Outside of a surge in nationalistic activity in the various German states in the preceding decade, we did not discover any significant deviations in the history of TCE until 1848. In that year, in our history, a number of popular and nationalistic movements threatened to or, in a few cases, succeeded in changing the political structures of many countries in Europe."

Robbins listened as Velikovsky described events he only vaguely recalled from the historian's orientation lectures. Demonstrations and riots in Vienna and Berlin in March, 1848 which forced the royal family of the Austro-Hungarian Empire, the Hapsburgs, to flee their capital and threatened to topple the other major German state, the Kingdom of Prussia. The calling shortly thereafter of the

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Constituent National Assembly in Frankfurt. Its purpose was to try to unite all the independent German states—Prussia, a hodgepodge of much smaller principalities and cities in middle and southern Germany, and the Hapsburgs' empire composed of Austria, Hungary, and much of central Europe—into a single nation.

In the end, Velikovsky said, that attempt failed. By 1849 the reactionary factions, the ones who supported the political status quo, had won. The first successful steps towards German unification were delayed until the mid-1860s. Through the *Realpolitik* policies of Prussia's "Iron Chancellor," Otto von Bismarck, that kingdom and the smaller German states were united in 1871 into the German Empire with the king of Prussia, William I, as its Emperor. The Hapsburgs continued on their own separate path, their Austro-Hungarian Empire marked by a growing decadence and military weakness until its political incompetence touched off the First World War in 1914. Except between 1938 and 1945, the Germans in Austria never were a part of the nation that became "Germany."

"That is what happened in our history and," Velikovsky continued, "until recently, on TCE. But while our history has not changed, that of TCE certainly has. There, in 1848, Prussia, the smaller German states, and the entire Austro-Hungarian Empire were united into the Pan-German Empire, with the Hapsburg ruler Ferdinand I assuming the title 'Emperor of All the Germans.'

"Such a major change in the political structure of Europe—a new nation of over 75 million people in the very middle of the continent, much larger than any except Russia—produced a history far different from ours. The event which almost cost Dr. Robbins his life in 1852, one which never happened on our Earth, was the near-capture of Vienna, the capital of the new empire, by the army of Czar Nicholas I. The German forces under Prince Alfred von Windischgrätz were finally able to repel it, and a week later won a decisive victory over the Russians at the Battle of Olmütz. The French, under the newly self-crowned Napoleon III, also launched an attack as the Russians were threatening Vienna. They were more successful, defeating the Germans near Cologne. After an armistice, they forced the Pan-German Empire to cede all territory west of the Rhine to their own Second Empire."

He went on, adding more details. The Franco-German war of 1868, ending with the execution of Napoleon III and the installation of a German prince on the throne of France. The successful invasion and subjugation of Russia in 1878 by a general named Moltke, with a member of the German royal family placed on the throne of the Czars.

"—And with the formation of the Anglo-German Confederation in 1892, all of Europe, North Africa, the Middle East, and Australia were under the direct or indirect control of the Pan-German Empire. Over the next two decades the Confederation extended its influence to include all of Africa and, after a bloody war with the Em-

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pire of Japan, Asia. By 1912, except for those countries in the Western Hemisphere which were not possessions of formerly-independent European nations like Great Britain and Spain, a "Pax Germanica" extended across TCE.

"Except for different patterns of immigration to it in the late 19th century and, of course, no war with Spain in 1898, until 1912 major events in the United States were very similar to those on our Earth. That year, Woodrow Wilson was elected president on an 'antimonarchist' platform. It included his 'Ten Points,' calling for the 'liberation of the enslaved peoples of the world, the establishment of democracy, and the right to national self-determination.' That began a period of forty years in which the US waged an ideological, indirect war against the Confederation that included fomenting civil unrest, terrorism, and guerrilla wars using proxy 'national democratic liberation front' groups within its borders. In the early 1950s, however, this 'cold war' reached a crisis after the successful invasions of Cuba and Canada by the United States, and the overthrow of the republican government of Mexico by a Confederation-backed local faction and its replacement by a monarchy headed by a Hohenzollern prince."

Velikovsky paused. "To understand what happened next, remember that nearly all of the important scientific figures from 1848 on we are familiar with still existed on TCE. For example, Albert Einstein, Edward Teller, and Wernher von Braun did similar pioneering work, but never emigrated to the United States. Those born in America, like the Wright brothers, J. Robert Oppenheimer, and Robert Goddard had careers even more successful than in our history. Thus, the technology on TCE in the middle of their new twentieth century was as advanced or, in some cases, more advanced than at the corresponding date on our world."

Velikovsky looked directly at Robbins. "On December 1, 1953, the United States of America launched a massive preemptive nuclear strike with its full arsenal of aircraft and missiles against the major cities and military installations of the Confederation. The latter retaliated in kind."

There was a long silence. "It was difficult to assess the full range of destruction produced immediately, and by the later effects of residual radiation, plague, and the famine caused by the resulting 'nuclear winter.' We estimate that three billion people—85 percent of the total population of TCE when the war began—had died by the end of 1954. After 1996, we've been unable to find any survivors."

I did it, Robbins thought to himself. *I don't know how, but I killed all those people.* Eyes closed, he didn't dare look at the rest of them. Especially Antonia.

From a distance he heard Velikovsky say, "There are two important questions we must answer. What caused this catastrophe? And can we do anything to change it? I will defer the latter question to Dr. Everett. As to the first, I would like your opinion, Dr. Robbins."

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Reflexively he opened his eyes.

Velikovsky said, "Computer, display."

A holographic display appeared in the middle of the table.

"This is a recording made in Frankfurt on July 4,1848 at the official announcement of the formation of the Pan-German Empire." The recording must have been taken from the top of a tall building. Robbins looked down at a sea of cheering humanity in the great open area, and a dais on which stood bemedaled dignitaries. At ground level, near one end of the raised platform, he noticed a military band that seemed ready to start playing.

"The man speaking," said Velikovsky, indicating the walrus-mustached figure speaking softly in German in the middle of the image, "is the same Baron Otto von Bismarck I mentioned earlier. In our history, he was one of the many nobles in the Prussian and Hapsburg courts who opposed German unification in 1848. In the revised history of TCE, however, for reasons we still do not fully understand, they were among its most enthusiastic supporters." The tiny figure in the display concluded his speech with a generous sweep of his arm toward "our new Kaiser." As if on cue the band started to play a powerful, triumphant, martial tune.

Robbins felt his flesh turn cold. *Now* he understood. As they sang together the faces of the tiny figures in the recording showed a mixture of pride, fervor, and single-minded patriotism. Workers, peasants, aristocrats—men and women, people from every level of society, different in so many ways, but all united in a common cause—in their love for their country. Right arms raised in a salute to their new leader, they shouted the words to the song passionately, in complete, fanatical unity—as if they were now inspired to go out and conquer the world.

It all made sense. He thought of the armies of Revolutionary and Napoleonic France, marching out to the strains of *La Marseillaise* to overrun Europe. Or the Germans of the twentieth century on their Earth, with *Deutchland über alles*. Even the English, perhaps, during their days of Empire, with *God Save the King*. A memory from his childhood came back to him—the time his father had taken him to a baseball game. The swelling pride he'd felt at being an American, standing with the rest of the crowd, as he'd heard *The Star-Spangled Banner* sung for the first time.

The people in the recording seemed to feel the same thing, but many times more intensely as they sang their own anthem. *Aufstehen!* ("Arise, ye German sons, unite!") A song whose melody was based on the primary theme of the fourth movement of Beethoven's final symphony.

The A minor.

The triumphant Tenth.

"Dr. Robbins?" Velikovsky was speaking to him. "Dr. Brentano says you're familiar with the song these people are singing, and that it might have a bearing on the question we are discussing. Is that correct?"

"Yes," Robbins said. "But first—could you please turn off that recording?"

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* * *

After the others had a little time to absorb what he'd told them, Robbins turned to Everett, who was sitting by herself in the far corner of the room. "Is there any way we can undo all this? Change things back the way they're supposed to be?"

She nodded. "I think we can. At the science committee meeting earlier this afternoon, Harrison said the vaccine-blocking agent the late Dr. Ertmann tried to use would still be effective even if it were given up to twenty-four hours after you injected the vaccine. All you have to do is translocate to Beethoven's apartment again, say thirty minutes 'after' you gave the vaccine, and inject this neutralizing agent into him. Theoretically, that would undo what's been done to this point, and TCE would return to 'normal.' I propose that you do just that."

That's all? That's all I have to do? He looked down at his hands, clenched them, then opened them. *I destroy worlds, then I create them again—.*

But not anymore. He had no desire to play God. After this one last time, he swore never to go back to TCE again.

The Chancellor said, "Is there a second for Dr. Everett's proposal? All in favor? Opposed? Let the record show that the humanities committee has voted six to zero in favor of her proposal."

Robbins sighed. The sooner he did it the better he'd feel—.

"And that," the Chancellor continued, "brings us to the second item on our agenda. Dr. Velikovsky has submitted a proposal which was approved by the executive and science committees earlier today. It involves setting up a special task force to review future projects for changing the history of TCE. The applicability of this proposal is, of course, contingent on Dr. Robbins's anticipated success in returning TCE to its original state. If he does, and this proposal is approved by the committee today, the task force will—."

"What?" The Chancellor looked startled at Robbins's interjection. "Are you saying that, if I do make things right on TCE, you're going to let someone else go back and change them again?"

Velikovsky said, "Precisely. You have shown it is possible, with appropriate manipulations, to change TCE's history without changing our own. Thus, instead of passively retrieving lost information as we've done in the past, we now know we can use TCE as a vast laboratory for studying the effects of carefully selected changes on subsequent political, scientific, and artistic developments. After each such experiment is finished, we can go back and, as you will be doing, undo that change and reset TCE's history to its 'default' condition."

He smiled warmly at Robbins. "Although the change you caused had, in that particular history of TCE, disastrous consequences for its people, we here on our Earth have benefited greatly. The dynamics of what is, to us, an 'alternate' history will provide enormous material for analysis and review for years to come. And this is

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just the beginning. We all owe you a debt of gratitude for showing us what can be done."

Robbins wished he still had that gun he'd dropped on TCE. "Do you realize what you're saying? You're talking about deliberately manipulating, possibly destroying billions of innocent people for the sake of an 'experiment'!"

Velikovsky looked pained. "Not real people, like us. 'Shadow people,' in a 'shadow history,' without a real existence of their own. As Dr. Everett has said, they live in a 'pliable' past that is not truly 'real'—."

"Don't you dare misquote me!" Everett interrupted. "You know what I think of your proposal!"

Robbins glared at Velikovsky. "They are real! Flesh and blood! I saw them! I touched them!" *I killed four of them personally!* "They can be hurt, they can feel pain just like us—and we have no right to play God!"

"Order, order!" The Chancellor looked angry. "We must discuss this proposal in a civilized manner. You and Dr. Velikovsky have had your say. Does anyone else wish to comment?"

There was another round of shouting, this time with Antonia on one side and Lytton and Shimura on the other. For every "Shelley" that Lytton mentioned or "van Gogh" that Shimura brought up, Antonia countered with "And how many billions of people have to suffer and die to get those few extra poems and paintings?"

Billingsley said nothing. Just fiddled with his bow tie.

After the arguing died down the Chancellor said, "Is there a second for Dr. Velikovsky's proposal?"

"Seconded!" Lytton and Shimura spoke simultaneously.

"All in favor?"

Velikovsky, Lytton, and Shimura raised their hands.

"Opposed?"

Robbins's arm shot up first, then Antonia's. Billingsley raised his lazily.

"Let the record show that the humanities committee has voted three to three on Dr. Velikovsky's proposal." She paused. "As per our by-laws, I must now cast the tie-breaking vote. Based on the positive recommendations made earlier today by the executive and science Committees, I feel that I too must vote in favor of the proposal. Let the record show that—."

"That does it!" Antonia's face was crimson. "You little tin gods can play your games with peoples' lives by yourselves! I have nothing but the utmost contempt for you, and refuse to be a part of it!"

She stood up. "I resign from the Institute! Good-bye!" She glared at Robbins and sneered in a low voice, "You and your damn music!" Then she left the room.

"What a woman." Billingsley said suddenly. He stood up. "I didn't say anything before we voted because everybody had their minds made up already. Now, I'll just say that a person can stand for a lot of pushing if they have to." He paused. "But there are some things a person can't take. I resign too."

He moved toward the door. "It's sad. I used to think we were the good guys. That we were Earth-One. Looks like we're really Earth-Three.

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"And for those of you who don't get that one, here's another twentieth century term that seems appropriate right now. A.M.F.!" Billingsley's last words as he left the room were what that acronym meant.

Robbins blinked. He'd never seen the Chancellor blush before.

Recovering her composure she said, "Any more business? Then this meeting is adjourned."

The others began to stand, say their own good-byes, and leave. Robbins stayed in his chair, alone with his memories and regrets. Faintly, deep within him, his mind played through the final Adagio of Haydn's "Farewell" Symphony. As each instrument played its plaintive "auf Wiedersehen" and left, all the things he had hoped and lived for, everything that brought meaning to his life, seemed to go with them. Finally, as the two remaining muted violins closed the work softly in the distant, lonely key of F-sharp major, he got up and left too.

Back in his own apartment, he felt a little better. Harrison had sent a message for him to get a good night's sleep before going back to deliver the vaccine-blocker in the morning. He sat down at the Steinway and, wincing occasionally from the pain in his upper back, began to play. But the pieces his fingers selected made him feel depressed again. The third movement of Chopin's Sonata no. 2 in B-flat minor, then Haydn's Variations in F minor. As the last questioning notes of the latter work's coda faded away, the doorbell rang. Praying it was Antonia, he opened the door—.

It was Everett.

"May I come in?"

She sat down on the couch. He sat down beside her.

"Nice piano."

"Thank you."

Everett looked at him sadly. "You look depressed."

"Of course I am!" Everett's hair shimmered like spun silver in the muted light. Almost like an older version of—. "If I go to TCE and manage to undo all the damage I've done, Velikovsky and the others are going to use all those people as guinea pigs for their 'experiments'!" *But isn't that what you did? No, I was trying to do something good for them and us! Tell that to all the people you killed.* "And if it doesn't work, I'll still be responsible for the death of billions of people—the whole human race there! Either way, it's all my fault!"

"No it isn't. It's more my fault than yours. I could have vetoed your proposal anytime. You wanted your music, I wanted to prove we could change TCE's history without changing ours. We both got want we wanted. Just not what we expected."

Everett moved closer. "How much of that report about TCE I sent out three weeks ago did you understand?"

Robbins rolled his eyes.

"Oh. That much. Well, I'm not very good at asimoving, but I'll try. The key thing you have to understand is, at any instant in time, 'choices' are being made. At the smallest scale, a radioactive atom may 'choose' to decay or not decay. When you get up in the morning, you choose to part your hair on the right or the left. The 'pre-

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sent' is the sum of all the specific choices and decisions made in the past. Nearly all those choices are 'trivial,' in the technical sense that they don't lead to any 'significant' difference in the history of the Universe. They might affect only an atom or, at the macroscopic level, only a tiny portion of the cosmos. But, occasionally, one of them makes a 'critical' difference."

She paused. "On September 17, 1666, someone, or something made a choice which—god, nature, whatever you call it—considered so important that it caused our Universe to split into two branches. In one branch, one 'choice' was made, some event occurred—and in the other branch, it didn't. On November 9, 1998, the same thing happened, due to some other choice. What we perceive as the 'real world' is just one of those latter two 'branch' universes. What we call TCE is the discreet timeline, the 'history,' between those two branch points in 1666 and 1998.

"If you're wondering what the actual choices were that made the Universe split in those two particular years—well, I wish I knew, too. But I do have some guesses. In 1666 Isaac Newton—You've heard of him, haven't you?—was doing some of his most important work." She smiled wryly. "It's supposed to be a myth but, maybe, in the other branch universe, the apple 'decided' *not* to fall.

"As for 1998—well, I've never told anyone this before. People think I have delusions of grandeur as it is. I was in my high school library that day looking for a copy of *Little Women*. I went down the wrong aisle, and happened to see a set of the *Feynman Lectures on Physics*." A sad, faraway look came to her eyes. "Perhaps, in that other branch universe, there's no transcosmology. Maybe, at this moment, I'm a retired English teacher playing with my grandchildren."

She sighed. "We can't physically travel to any of those other branch universes, or back into the 'past'—that is, from 1998 to 'now'—of our own particular branch. Actually, we might be able to do it someday, if you believe in stable wormholes—which I don't. On the other hand, folding space-time to travel to TCE, which is in a null energy state relative to our branch Universe, is fairly easy. It's like temporarily reconnecting an umbilical cord between a baby and its mother. We use a—."

She noticed the blank look on his face, then muttered a word that sounded like "reason." "Never mind. You don't really need to understand why this should work, just what you have to do."

Her face moved closer to his. "I have a plan. It's more dangerous than anything we've done so far. Depending on how strict nature is about violating causality, it might not even work at all. But it's the only way we can make everything right on TCE, and here."

Robbins's eyes opened wide. "How?"

"As I said, we can't physically travel back into the past of our own branch Universe and change things that have already happened. But, by using TCE,

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we might be able to change them by a less direct method." She smiled. "Actually, this idea isn't very original. I first read about it in some old science fiction stories when I was in college."

"Science fiction?"

Everett looked at him quizzically. "Do you read science fiction too?"

"No, but maybe I should." He started to ask her if the idea she was referring to was in "graphic novels" too, but thought better of it.

Everett reached up and took a book of piano music from the top of the Steinway. Taking a pen from her purse, she began writing on the book's blank back cover. "This is what you need to do—."

Robbins's eyes opened wider as she explained her plan.

"But didn't you say it was dangerous to—?"

"Believe me, I wish there was another way!" She handed him the book. "Will you do it?"

Robbins looked at the instructions she'd written on it, then turned it over. It was his copy of Beethoven's Sonata in E-flat major, Opus 81a. He leafed through the score, remembering the subtitles the composer had given to its three movements. *Les Adieux. L'Absence. Le Retour.* Then he turned the book back over and reread what she'd written.

"Well, Dr. Robbins? It's your choice."

He sighed. "If it's the only way to make things right—of course I'll do it."

With a sense of *déjà vu* Robbins entered the Portal Room after changing into a NOC suit. Miles, Everett, and Harrison were there again—just like when he'd gone to TCE and prevented Ertmann from injecting Beethoven with the same medicine he was supposed to give him now.

Harrison handed him the injector. "I've loaded it with the vaccine-blocker. Inject it the same way you did the vaccine."

From his place at the control panel Miles said, "The portal is stable and active. Spatial coordinates are the same as when Dr. Robbins translocated to inject the vaccine. Temporal coordinates are set for . . . twenty-nine minutes and counting after he returned from that translocation."

"Let me check those coordinates." Brushing the technician aside, Everett scrutinized the panel carefully.

Injector in hand, Robbins walked to the entrance of the portal, waiting. He hoped Everett knew what she was doing.

The latter's hand played briefly over the control panel.

Miles frowned. "Excuse me, Dr. Everett, but why did you change—?"

"Dr. Robbins," she said, pointedly ignoring Miles. "Do you remember everything I told you?"

"Yes."

"Then—good-bye!"

As the blackness of the portal enveloped him, Robbins ran over Everett's instructions once more in his mind. He hoped this wasn't just going to make things worse. But even if it meant his own destruction, he was determined to set things right. His last thought before he arrived was to remember what Everett said could be

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sent back into their own past via TCE.

Information.

Suddenly his thoughts were interrupted—he was there. His first breath brought a multitude of unpleasant smells. The NV goggles activated automatically in the dark room.

He was in the kitchen of Beethoven's quarters. A fireplace filled with musty ashes was set into one wall. The room had several tables and open shelves, with plates, bowls, and utensils on them. A wicked-looking knife lay on one of the tables. In one corner stood a dusty, dilapidated pianoforte. Robbins smiled slightly, thinking how ironic that was.

Slowly, he entered the main living area, carefully avoiding bumping into the small writing desks and chairs scattered around it—.

"Stop."

Robbins froze, terrified. Slowly, his head swiveled in the direction of the whispered word. His NV goggles revealed another person in the room. Someone about his height, and wearing a NOC suit just like his.

The strange man spoke again. "Don't go into the bedroom."

Robbins whispered back, "Who are you? What are you doing here?"

The dark figure stepped closer, and removed its goggles and hood. Robbins blinked, unable to comprehend what he saw.

It was his own face.

The man replaced the goggles over his eyes. "Don't talk, just listen."

Robbins nodded as the stranger spoke. Many of the latter's instructions didn't make sense but, he was assured by the other man, in time he would understand them. Robbins felt sick when the man told him why he had to do all those things right.

He did protest about injecting the vaccine he carried into the stranger's bare right arm, but obeyed. "They have to think you really did inject it into Beethoven, so you can't go back with the injector unused," the stranger explained, wincing as he rolled his sleeve back down and rubbed his right upper back with his left hand. "If everything works out the way it should, there's no way that can hurt me. And now you've been absent long enough. It's time for you to return."

Robbins followed the other man into the kitchen. "Are you coming too?" Robbins asked. The other man replied, "No. If Everett's right, and this works, I can't go back.

"Oh, one more thing." Robbins saw him walk over to Beethoven's pianoforte, and smile.

"Now, listen very carefully—."

"Are you disappointed it didn't work?"

Robbins shrugged. "I'll live."

Antonia sat next to him on the couch in his apartment, listening to the music with him. Eyes closed, she smiled dreamily as the symphony ebbed and flowed around them.

Draping his arm lovingly over Antonia's shoulder, Robbins closed his eyes too. He was still trying to work out in his mind everything that had happened in the three days since the Humanities Committee had approved his proposal. Especially after he'd

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translocated to TCE intending to give Beethoven the vaccine.

Just as the man in Beethoven's apartment had told him to do, immediately after he'd returned to Earth he'd gone to find Ertmann. Actually, he didn't have to "go" anywhere. She was still calmly sitting in that same chair in the Portal Room with Harrison and Miles nearby, just like before he'd entered TCE to inject the vaccine. As soon as she saw him, before he had a chance to say anything, Ertmann "confessed" to them that she'd gone back before and injected Beethoven with something to block the vaccine. At Robbins's suggestion, they'd called Everett to come to the Room and get her opinion on what they should do next. She had looked at him a bit suspiciously, as if to say *she* was the one who was supposed to suggest he go back a little "earlier" and confront Ertmann on TCE. But she'd agreed he should do it.

Back again in Beethoven's apartment, when Ertmann appeared he'd pleaded with her to trust him, said he was on her side, and told her what they had to do. And, he'd said finally, when you go back, please, please don't hurt yourself!

Then, after returning to Earth himself, he'd changed clothes and translocated back to Vienna on the morning of March 27, 1827. The newspapers there reported that Beethoven had died the day before—naturally, since he'd never injected him with the vaccine. Then he'd returned home once more—to "failure."

The hardest part was lying at the special humanities committee meeting yesterday that he'd done his best to prolong Beethoven's life. The others seemed surprised when he'd then asked to withdraw his proposal. He told them he'd had second thoughts about the possible disastrous consequences it might have for both TCE and their own world. He'd even used examples from the stories Billingsley had given him—and, most damning of all, the one the "stranger" in Beethoven's apartment had told him about.

The vote in favor of withdrawing his proposal was four to two. Lytton and Shimura were the holdouts, disappointed they'd never get a chance to try out their own pet projects. Robbins still wondered if he'd done the right thing, following all the instructions the man who said he was a "future" version of himself had given him. But, if you can't trust "yourself," who can you trust?

As he'd asked her, Ertmann had visited him in his apartment earlier this evening. He'd stressed that she should never, ever tell anyone about their "conspiracy." If anyone found out what really happened, they might try it again—and neither of them wanted that. Dorothy had thanked him for everything, especially the way he'd helped Harrison convince the Executive Committee not to dismiss her from the Institute. Then she'd given him a warm hug, planted a chaste kiss on his cheek, and left.

The memory of that hug lingered vividly in his mind. Robbins found himself having to suppress some very

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unplatonic thoughts. But no, he was a little too old for her. Besides, he already had a beloved.

The symphony was approaching its thunderous, explosive climax. Antonia snuggled closer to him. "Beautiful, isn't it," she murmured dreamily. "So ecstatic, so full of life and celebration."

"Yes," he agreed. "But not as beautiful as you."

As their lips touched and he lost himself in their kiss, the music seemed to fade for a moment, replaced by another melody—a powerful, triumphant, martial tune in C major. The one the man in Beethoven's apartment had tapped out on the pianoforte in the kitchen. Robbins wished the man had told him where it was from.

Antonia whispered softly in his ear, "Don't be too disappointed you didn't get your 'new' music. Remember, 'Heard melodies are sweet, but those unheard are sweeter.'" Then, her breasts barely grazing his chest, she looked shyly up at him. He had last seen that look in her eyes far too long ago, and knew she wasn't planning to go back to her own apartment tonight. Over her shoulder he glimpsed the bust of Beethoven on the Steinway. The ghost of an approving smile seemed to play on its plaster lips.

In the background, endlessly repeated booming notes by the full orchestra were followed by a skyrocketing upward glissando and the last fortissimo chords of Beethoven's final symphony.

The D minor.

The joyous Ninth. ■

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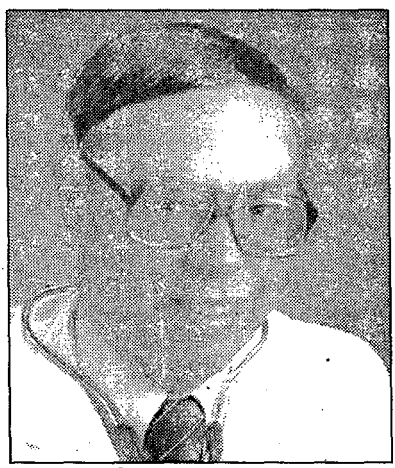
With SF writers and readers heavily into "tech" sciences, biological SF tends to come largely from physicians such as Henry G. Stratmann, MD. He grew up in a small town near St. Louis, MO, earned a BA in chemistry from St. Louis University, and an MD from Southern Illinois University School of Medicine. Five years of post-grad training followed in internal medicine and cardiology at St. Louis University for board certification.

As you might expect from an *Analog* contributor, Henry started adult life off as valedictorian of his high school, received a BA in two and a half years, and earned an MD at age 23. He is currently Associate Professor of Medicine at the St. Louis School of Medicine and director of the coronary care unit at a VA medical center.

Astronomy captivated Henry like most of *Analog*'s contributors and readers. One of his four telescopes is a home-built reflector, with a commercial 10-inch mirror. He began reading SF when he was seven. Appearing in *Analog* gives him a great deal of personal satisfaction. Most of his writing has been in medical journals, largely centered on nuclear cardiology. His physician wife is a nuclear radiologist.

Henry didn't think of writing fiction until his letter published in the August, 1992 *Analog* drew a nice note from writer Gerald Nordley. Supplying medical details, Henry collaborated with Gerald on "Tin Angel" for the July, 1994 issue. Another letter in the August, 1994 issue led to corresponding with Kevin J. Anderson. In addition to the writers' collegial atmosphere found in science fiction, Henry also has benefited from Stan Schmidt continuing the *Analog* editor's tradition of being writer-friendly. "His incisive comments on what I was doing right or (far more often!) wrong with my stories and his suggestions on improving them have been invaluable."



Henry G. Stratmann, M.D.

Obligations have kept Henry from

(Continued on page 152)

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THE REFERENCE LIBRARY Tom Easton

Starborne, Robert Silverberg, Bantam, $22.95, 292 pp. (ISBN: 0-553-10264-8).
One Mind's Eye, Kathy Tyers, Bantam, $5.99, 387 pp. (ISBN: 0-553-57511-2).
Angel, Garry D. Kilworth, TOR, $22.95, 320 pp. (ISBN: 0-312-86107-9).
Bellwether, Connie Willis, Bantam, $11.95, 248 pp. (ISBN: 0-553-37562-8).
The Dragon and the Djinn, Gordon R. Dickson, Ace, $21.95, 394 pp. (ISBN: 0-441-00297-8).
War of the Worlds: Global Dispatches, Kevin J. Anderson, ed., Bantam, $22.95, 274 pp. (ISBN: 0-553-10353-9).
Paragons, Robin Scott Wilson, ed., St. Martin's Press, $24.95, 368 pp. (ISBN: 0-312-14023-1).
State of the World 1996, Lester Brown, Project Director, Linda Starke, editor, W. W. Norton & Co., $11.95, 249 pp. (ISBN: 0-393-31339-5).

Robert Silverberg's latest will not satisfy readers who are looking for adventure, grandiose landscapes, or strange and quirky characters. He has chosen to consider a future when the human species has solved its problems and settled into its front-porch rocking chair to wind down its days. The population is vastly reduced, war is a thing for "remember-when" reminiscences, adventure is kid-stuff, not for front-porch grown-ups, and. . . . Well, you get the idea. Life has turned terminally boring.

Yet let's extend the metaphor a bit. If we consider the geriatric population, we see immediately that not all old folks are ready for the rocker. There are always a few out there on the ski slopes, climbing mountains, driving motorcycles too fast for safety. And the rocker-sitters do seem to enjoy hearing about the adventures of their more adventurous peers, as well as of their children and grandchildren.

Silverberg supposes that the few remaining adventurers have spark-plugged the construction of a starship, the *Wotan*. Fifty of them are aboard, journeying through "no-space," playing go, hoping to find a new world on which to plant a new humanity, perhaps with a bit of genetic engineering to suit them to the new environment, and reporting home each day through Noelle, blind

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and lovely and telepathically linked to her twin sister Yvonne, back on Earth. Yvonne in turn passes the reports on to the eager audience on the porch.

Starborne is the tale of the *Wotan* and its crew, of the year-captain's yen for Noelle, of the anxiety over whether they will find a world, of excitement and disappointment, and of the discovery that Noelle's telepathic voice is being drowned out by a mysterious static-like interference. In time, the interference becomes so bad that Noelle can no longer communicate with her sister.

What is the source of the interference? All the crew has is guesses, but when one suggests beings of some sort—call them "angels"—it is immediately clear that Noelle will have to try to communicate with them.

Perhaps you can guess the rest. It's been done before in various ways, and Silverberg's version is not remarkably satisfying, perhaps because he comes to it after a long buildup and then rushes through it to far too pat an ending.

Silverberg is immensely skilled, and he has earned a well-deserved following for his many, many contributions to science fiction. But I really don't think this ranks with his best; wait for the paperback.

It's been a while since I last reviewed one of Kathy Tyers's books, so I was pleased to see **One Mind's Eye** in the stack waiting for me. Sadly, I found it deeply flawed by reliance on an "empathy" that was really mislabeled telepathy and by a resolution that seemed to owe far more to the power of sheer goodness than to likelihood. It'll probably sell just fine.

That said, here's the setting: The Concord is a handful of worlds linked by mysterious gates, objects (left behind by long-gone aliens) that provide faster-than-light travel from system to system within the Concord. A few centuries back, the Concord was nearly destroyed by the Devastators; since then the people have been struggling to rebuild their worlds' biospheres. Only Tdegahas had it easy; for some reason, the Devastators failed to vaporize this world's seas and nearly sterilize its surface.

Unfortunately, Tdega won't share the nanotechnology that allows it to feed itself and send supplies to the rest of the Concord, including Antar, long the governing center of the Concord. Antar is about to send negotiators to insist Tdega share, even to "nationalize" the nanotech. Antar has its own plans—and just how nasty they are is only suggested by the realization that Tdega discriminates against "mutants" such as empaths.

Meanwhile, back on Tdega, meet Llyn Torfinn. She was found some years before, a child locked into an "Artificial Reality"(virtual reality) rig that had stunted her growth, atrophied her muscles, and warped her mind. The AR operator suicided before being questioned. Why remains a mystery. Llyn's fate, however, is no mystery at all. She was turned over to a therapist for rehabilitation; rehab has been successful enough that Llyn now wants some freedom from constant supervision, control, and pun-

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ishment; the therapist, however, has adopted her, turned exceedingly possessive, and refuses to let go.

Back on Tdega, Tyers introduces us to a dictator who also likes power, and to a brain parasite, still another controller, that makes Heinlein's Puppet Masters seem fairly benign (at least *they* could be squished; these are more like sentient bullets). The dictator thinks he can control such controllers, plans to forge an alliance with the parasites, and plans to turn people over to them for infestation.

Little does Antar know, though when Tdega secedes from the Concord, blows large holes in one Concord world, and destroys Antar's capital, it is very clear that something is wrong and *something must be done*. Unfortunately, Tdega has all the guns.

Of course, such minor drawbacks have never stopped the good guys. Llyn's true identity (she's a classic princess in exile) is discovered. Missions are mounted. And in the end, the forces of evil quite fail to play their cards with the sort of decisive force Tyers and common sense lead one to expect, which turns what has hitherto been an interesting consideration of controlling power into a bit of an idiot plot. So the good guys win.

If only real evil could always be trusted to turn incompetent at the end.

Garry D. Kilworth is a bit more subtle in **Angel**'s treatment of evil, and he has what is really a very nifty idea (though his writing is plainer, even clumsier, than Tyers's).

Here's the setup: In San Francisco and around the world, arson has become a serious problem. There are major fires every day, and sometimes they seem to start with an instantaneous explosion of white light, almost like a pocket nuke. Neither incendiary devices nor their remnants are found in these cases, and there is suspicion that all the non-"white fire" fires are but copycat imitations.

One day a cop notices a man of quite feminine prettiness staring at a building. He enters. A moment later, the building explodes in white fire, and the stranger leaves, strolling through fire so hot that steel drips. The cop notices that the stranger smells of almonds.

Detectives Dave and Danny are assigned to find the arsonist, but every effort is futile. Then Dave's wife and child die when a department store goes up in white flame. His motivation becomes extreme, but every effort is futile. Until. . . .

Kilworth lets his readers visit the stranger's thoughts long enough to know what is going on before Dave and Danny get a clue. (It's even on the book's jacket.) The stranger is an angel who has taken upon itself the task of pursuing and destroying the fleeing remnants of Satan's forces, demons who have gone to Earth amongst humanity. When it spots one, often hiding in high-crime districts where the demon's aura of evil may be masked by the surrounding miasma, the angel stalks its prey. When the angel gets close enough, it flames the demon. Human bystanders and architecture are irrelevant; after all, people are destined to die soon anyway, after which they will have their places in heaven

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or hell; their lives are nothing relative to eternity.

What do the demons do that makes them evil? Not much, from our perspective. They don't slaughter the innocent, much less rape, thieve, embezzle, or plagiarize. They're too busy keeping their heads down, avoiding notice as best they can. Their evil is that they defied god, refused to take orders, set their own thoughts first, chose freedom over subservience to an established order (pretty traditional American values, which is surely why some parts of the world refer to the USA as "The Great Satan").

Can Dave and Danny possibly solve their case? Can Dave get revenge for his lost family? They know what they're up against—the angel tells them—but that isn't quite the power of god. This angel, remember, is pursuing its own path. It has turned willful, and when it decides to swat these gadfly detectives by destroying an entire police station, it oversteps the bounds.

Its recall order comes. It refuses, and this is what topples the angel over the precipice. Like its erstwhile prey, it has now fallen. It may now be defeated, and even destroyed.

Kilworth raises an interesting question (Can good do evil?) in several ways, of which the angel is only one. Just as important to his theme are the corrupt probation officer and the theology lecturer and child abuse victim who sets her lover's bed on fire when he demands something intolerable. The probation officer shows us that evil hidden under a fair cloak can be hard to stop. The woman reminds us that what seems evil may be only illness, and that perhaps the best way to define evil is by the evildoer's eagerness to embrace destruction. She is thus not evil. The probation officer is.

And so is the angel.

The demons? Read the story, and see what *you* think.

Connie Willis's latest is a light, frothy, fun, and more than a little tongue-in-cheek rumination on the nature and origin of fads. **Bellwether** is set in HiTek, a Colorado research firm that would dearly love to come up with a way to predict fads and trends, or—better yet—learn how to initiate them at will. If successful, it will obviously have in its hot little hands Madison Avenue's own Holy Grail and the money will roll in by the truckload.

It is therefore funding sociologist Sandra Foster's effort to track hairbobbing to its roots. She's happy, for she has a lovely puzzle to work on. On the other hand, she also has to deal with Flip, the mail girl—er, the "interdepartmental communications coordinator," or whatever other trendy, status-enhancing label Management has come up with lately—who has a powerful tendency to lose mail, misdeliver mail, and "clean up" piles of research material, all while finding new ways to adorn herself with the absolute latest in pop colors, duct tape, skin brands, hairstyles, and so on, while complaining of how overworked she is. She also has to deal with Management's enthusiasm for trendy acronyms, group hugs, and new, improved, more efficient procurement and funding-application

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forms, each version 30 pages longer than its predecessor and more loaded with incomprehensible jargon. Not to mention Management's drive to figure out what sort of research wins the prestigious, rich, and capricious Niebnitz Grant, and thereby to enhance its own chances of cashing in.

You get the picture, I'm sure. Willis builds up the situation with plenty of examples of fads and highlights their silliness by letting Foster discover a biologist who seems quite immune to them (Flip calls him "fashion-impaired") and grow frustrated with the apparent lack of origin for fads. And let's not forget Flip's new assistant, a paragon of industrious efficiency who—heaven forfend!—actually smokes!

Where does it all go? The title says it all to anyone who knows a bit about animal behavior. A bellwether is the sheep the rest of the flock follows. It isn't a particularly take-charge sort of sheep, but it always seems to be out in front, and that's enough. And of course, there's some fairly low humor once HiTek installs a flock of sheep as research animals.

Toss in chaos theory—a bit trendy itself—and you have *Bellwether.* For once, the jacket copy does not exaggerate when it calls it "thoroughly entertaining."

The series Gordon R. Dickson began when he returned to his 1976 story, *The Dragon and the George,* has now reached its fifth added volume.

The Dragon and the Djinn continues the tale of James Eckert who, magicked into a rough parallel of Earth's fourteenth century, found himself in the body of a dragon, discovered that he was not only a part-time dragon but also a low-level wizard, and got handed a baronetcy, a small castle, and a continuing series of magical problems involving snotty dragons, sea serpents, giants, trolls, knights errant, and magical overdrafts.

The current volume is considerably defter (less talky) than the last, which centered on a twelve-day Christmas party; I enjoyed it more. It opens about a month later, when James's friend Sir Brian arrives at Malencontri castle to invite him along on a quest to Palmyra, where his dearly beloved's long missing father has been sighted. The object of the quest will be to retrieve the old man and gain his permission for a wedding.

Alas, James has events at home to hold his attention. Sir Brian goes off. A few weeks later, James is released from home duties and, after a stern admonishment from the mage Carolinus to husband his magic carefully—he may need every scrap before he's done!—he is off himself, the hobgoblin from the castle chimney riding in his hood. He hopes to catch up with Sir Brian in Cyprus.

A brief encounter with a djinn disguised as a small dog seems to lead nowhere. James finds Brian guesting with a scoundrel knight who cheats at dice and helps the scoundrel fight off some very rough Moorish justice. They join a caravan heading for Palmyra and are kidnapped by Hashasheen. They escape and reach Palmyra, and finally they realize that

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they are caught in a swirl of demonic plots. Fortunately, as always, James's magic and cleverness are enough to see him through. The quest is fulfilled, Sir Brian will be a happily married man, the world is saved . . . but wait! There in Malencontri's courtyard, isn't that a giant? What does he want? And who's the ugly little fellow with him?

Tune in next time. It looks like Dickson isn't done yet.

The classics of science fiction are long and often imitated. They are used as starting points for extensions (*The Further Adventures of* . . . e.g., Wells's Time Traveller, or Tarzan, or Doc Savage, or. . . .), rebuttals (*What Really Happened at the* . . . e.g., OK Corral), modernizations (Caidin's *Buck Rogers* is a recent example), and so on. Sometimes the motive seems to be homage, sometimes money, sometimes sheer cleverness. A nice example can be seen in Kevin J. Anderson's **War of the Worlds: Global Dispatches**, whose premise can be put like so: "I wonder what Teddy Roosevelt or Pablo Picasso or Jack London was doing when those Martians were laying waste the English countryside?" He then drew up a list of people who either were famous at the time or became famous later (e.g., Winston Churchill) and invited as many writers to tell their tales (Howard Waldrop's "Night of the Cooters"—Martians vs. a Texas sheriff—is the only reprint).

Who told whose tale? Well, we couldn't really ask for a more natural pairing than Mike Resnick and Teddy Roosevelt. Doug Beason does Einstein. Janet Berliner does Churchill and H. Rider Haggard. Anderson himself does Percival Lowell. Robert Silverberg does Henry James as a tour de force of imitation. Connie Willis does Emily Dickinson. Daniel Keys Moran does Mark Twain. Don Webb does H. P. Lovecraft. Gregory Benford and David Brin team up to do Jules Verne.

The result is quite interesting, but perhaps not in the way it should be. The stories are clever enough, and the writing is fine, but the gimmick does dominate. Waldrop got a lot of attention for "Night of the Cooters" when it first appeared a decade ago partly because it was unique. If its appearance here were its first, it would be the same story, but its jewel-like shine would be dimmed by its shared-gimmick surround.

Is there any way around this problem (if it truly is a problem to anyone but me)? Perhaps such gimmicks would fit better in a magazine whose editor could announce that over the next year or so, the mag would publish a series of shared-gimmick stories. Each one would then have a better chance to stand out, and it might even make a nice marketing gimmick.

Robin Scott Wilson has been a science fiction writer and an academic, but he is best known in SF for his founding (with Damon Knight et al.) of the Clarion SF Writers Workshop in Milford, PA, which almost 30 years later is still running at Michigan State University and in Seattle, Washington. Clarion has been enormously successful in terms of both the number and

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the variety of writers its workshops have produced. The system it has developed works, has been much imitated, and is well worth a little bragging.

Perhaps **Paragons** is that brag. It's a workshop book, a handful of examples for writers, with comments. There's even a section on the operation and jargon of workshops. But the examples are the heart of it. Wilson has done "minor rewrites" of several short essays he did some 25 years ago, on plot, character, setting, theme, point of view, and style. Following each essay, he has set a pair of stories to illuminate his points, each with discussion by the story's author. With plot, we find Nancy Kress's "The Price of Oranges" and James Patrick Kelly's "Monsters." With style, we see Pat Cadigan's "Pretty Boy Crossover" and Howard Waldrop's "Fair Game." The choices are all apt, often familiar, and quite frequently interchangeable (of course; plot and setting, etc., don't exist in isolation).

As an anthology for the general reader, *Paragons* works just fine. It has a marvelous set of stories with enough variety to keep the reader from being bored. As instruction for beginning (and even experienced) writers, it can't possibly hurt and its approach (here's the general idea, here's an example, and here's why the author did what he or she did) may very well help.

On the other hand, there isn't a book on the planet that can *make* you a writer. Many can point the way, give tips, and encourage, but the making is up to you.

And this is where workshops can help. They can't *make* you a writer either, but done the Clarion way, you can't play unless you have a manuscript in hand. That is, you have to be putting those words on paper. The workshop then gives you the positive and negative feedback necessary for improvement. Then, with luck, away you go to fame, fortune, and Hollywood.

Let me tell you about a very interesting and alarming—yet perhaps not alarming enough—book. It comes from the Worldwatch Institute in Washington, DC, a group headed by Lester Brown. For many years, the Institute has been monitoring and reporting on environmental trends worldwide. Its magazine, *World-Watch,* is an invaluable alerting system; its yearly *Vital Signs* is an astonishing collection of trend data; its numerous other books and reports are very well respected.

The book at hand is from another yearly series. It's **State of the World 1996**; its chapters cover several of the most significant areas of planetary change—climate, food, water, disease—stress the needs to uphold human rights and to exploit our world in a sustainable fashion, and point to a number of promising signs.

The most important chapter is surely the first, in which Lester Brown argues that because of population, technological, and economic growth, "The pace of change in our world is speeding up, accelerating to the point where it threatens to overwhelm the management capacity of political leaders." Indeed, he makes quite clear, what threatens us is not just too-fast

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change, not future shock, but catastrophe, and catastrophe that we cannot avoid "if we keep sleepwalking through history."

I say the book may not be alarming enough because this very definite tone is softened elsewhere, when the book tries to be upbeat (after all, its subtitle calls it a "Report on Progress Toward a Sustainable Society"), to say that at worst how we will avoid catastrophe "is not clear." However, the book remains immensely valuable for a wealth of factual material and careful analysis that makes it very difficult to "keep sleepwalking." Very meaty, very provocative, very much deserving to be read by everyone, who then, even if they prove unable to avoid catastrophe, will at least walk over the precipice with their eyes open.

It's also very affordable. ■

(Biolog continued from page 144)

attending SF conventions, but he hopes to get to a Worldcon to meet the three gentlemen in person who have helped him develop as a writer. Foreseeable stories will probably speculate about the impact of medical advances on the individual. Later, he'd like to try other types of stories such as "alternate histories."

Like all SF writers, Henry is interested in a diversity of areas, such as electronics, computers, classical music, and rocketry. Given the life-and-death nature of cardiology, *Analog* readers can only hope to get a tithe of the interesting stories Henry could turn out as a full-time writer. Many *Analog* contributors have been multifaceted individuals who have a love for science fiction. This results in stories by writers collectively acquainted with the entire spectrum of human knowledge. ■

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BRASS TACKS

Dear Editor:

Regarding "The Copyright Notice Case" by Paul Levinson in the April 1996 *Analog,* I feel this story, while a fine esoteric detective story in its own right, is pure fantasy and not SF.

Yes, I know about technology sufficiently advanced being indistinguishable from magic, and all that. And I would have accepted it as plausible that the Copyright Notice, when read, would cause a "hidden brain program" to activate and kill the reader; and this is where I thought the author was going at the beginning of the story. But when he made the mechanism the computer, he lost me.

As a programmer by profession, I know that there is no possible mechanism by which the mere act of copying a file (which, to a computer, is essentially an inconsequential sequence of bits) can cause the computer to behave any different than copying any other sequence of bits. Granted, a so-called computer "virus" (which is really nothing more than a program that has to be currently running in the computer) could conceivably scan the contents of a file while it is being copied and perform a special function if it finds a certain bit sequence—and, in fairness to the author, perhaps he was thinking along these lines. But if you were to establish a pristine, i.e. virus-free, computer and then simply copy a file from disk A: to disk B:, there is no rational explanation of how the contents of the copied file could alter the computer's behavior.

Furthermore, there is no program, "virus" or otherwise, that can be processed by which a monitor can be made to emit light in any spectrum beyond that of the phosphor(s) on its screen. Also, the electron gun and the phosphors would have burned up before the screen could emit light bright enough to do permanent physical damage to someone. Should a malicious programmer uncover a mechanism to take direct control of the electron gun (which would have to be part of the computer's electronic circuitry to begin with), and burn it out in a sudden burst of brightness, the absolute worst he could do is give someone temporary blindness—you know, spots before your eyes. However, digital information stored by the computer simply cannot alter the physical structure of the computer hardware—period. This aspect renders his story as pure unabashed fantasy.

Perhaps the author has, in fact, postulated some mechanism that is not apparent. If so, he failed to describe it sufficiently in his story. Perhaps his

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mechanism would have acquitted his story for me. Alas, he did not present it, and so I feel this omission is a serious one in that it rendered his story as fantasy rather than SF.

I ask the author this: What would have happened had one of his protagonists, Phil D'Amato or Jenna Katen, simply read the text of the screen aloud (which the computer doesn't react to in a hostile manner) while the other, in another room beyond the computer's "sight," wrote it down on paper by hand? Would the pen have blown up in their hands? I'd like to know! If not, they would then have had their copy which they could then photocopy endlessly without incident. But if the pen had blown up, or had the computer "known" that somebody was copying the words and flashed its screen, that would have rendered the story equally impossible to accept as SF.

To a programmer, this story is akin to a writer blatantly violating the law of conservation of matter and energy in a hard SF story without giving a plausible explanation (which I suspect you would reject, or at least challenge the author on before you buy the story). And, since I don't see any little bitty 7pt. type that says "a spoof," he can't use K. Throop's defense.

BERNIE GALLAGHER
575 Easton Avenue, Apt 8J
Somerset, NJ 08873

The author replies. . . .

Bernie Gallagher raises interesting questions, most of which I've addressed already in my responses to other correspondence, so I'll be brief and make reference to these previous responses where appropriate:

1. A "hidden brain program" could certainly have been a suitable alternative to the mechanism in my story—as I indicated to Chris Easton, science fiction thrives on alternative scenarios. Indeed, in as much as the circadian response to the light that *is* the mechanism in "The Copyright Notice Case" is currently only partly understood by science (see #3 below), we could say that my story did indeed posit a hidden brain program.

2. Mr. Gallagher eloquently answers his own question about how a computer could differentiate the copying of one file from another: "Granted, a so-called computer 'virus' . . . could conceivably scan the contents of a file while it is being copied and perform a special function if it finds a certain bit sequence. . . ." QED.

3. The story doesn't at all insist that the computer emit a light beyond the spectrum "of the phosphor(s) on its screen"; the story says the computer emits a light that radically adjusts circadian rhythms—and circadian rhythms can be drastically affected by bursts of even common daylight. Indeed, the relation between circadian rhythms and light on the optic nerves is one of the hottest research areas in medicine: the Medline database lists some 2,576 studies in this area in the past few years, detailing the ways circadian rhythms influenced by patterns of light have profound impact on growth rate, estrus cycles, hormone levels, and like internal regulating factors which, if carried to an ex-

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treme, might well have life-and-death consequences.

4. Phil or Jenna could no doubt have the read the text aloud, copied it down on paper, etc., with no ill consequences—much as someone could do the same for any text currently in copyright, with no violation of copyright entailed. The framing and implementation of copyright, as I discuss more fully in my reply to Chris Easton, is indeed idiosyncratic—and, indeed, the problem of intellectual property is one of the threads of my story. (It will be treated more fully in my next nonfiction book, *The Soft Edge: A Natural History and Future of the Information Revolution,* to be published by Routledge next year.)

I enjoyed Bernie Gallagher's letter, and hope he keeps reading my stories and offering his commentary.

PAUL LEVINSON, PH.D.

Dear Dr. Schmidt,

Well, I certainly had some trouble suspending disbelief while reading "The Copyright Notice Case," by Paul Levinson in *Analog,* April 1996. Even though it was the April issue, you really should provide some clue that you are "having a lend" of your readers where that is the case.

In the following text I have had to use the character "!" to represent either astonishment or the "factorial" operation of mathematics. This ambiguity has been forced on me by the limitations of our shared encoding system. You will have to figure out which one I mean from the context.

I had a great deal of difficulty bridging the gap between my somewhat fuzzy picture of current genetic engineering's glassware, machinery, esoteric materials and computers and the traceless accomplishments of my proto-Indo-European forebears. I covered that gap by insisting to myself that, in many cases, the more sophisticated the understanding of field, the more simple become operations in that field. It still took a pretty deep breath!

The gap my mind refused to leap, however, was the one between binary-coded nucleotides (no problem) and ASCII. Now, I concede that my knowledge of proto-Indo-European is sketchy, but I am confident that there was no script some eight thousand years ago to limit the number of representations of that language's phoneme set. Modern variants of English use, I believe, about 45, scrunched to a much-abused set of 26 characters. I think it would be fair to guess that proto-Indo-European would have used between 30 and 50. Thirty-two phonemes can be encoded with 5 bits in 32! (Approximately 2.63 x 10 to the 35th power) ways (gasp!). If proto-Indo-European had more than 32 phonemes or they wanted to add a few characters to improve the richness of texture in their message, they would have gone to 6 bits and 64! possible encodings. Modern ASCII, such as is used by the computer I'm writing this on and which I believe the author was referring to, is a bizarre 8-bit encoding, with a 7-bit ancestor. Gasp! Stretch! The gap is too wide!

Wisely, the author did not actually state that the DNA message was encoded in 8-bit characters. The only

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"stops" mentioned were between sentences and paragraphs. What about word stops? If it were encoded in 8-bit characters, there would surely have to be a majority of "non-coding" characters unless the proto-Indo-Europeans had a lot of phonemes and they made elaborate use of such things as upper and lower case, subscripting, superscripting and punctuation. Such an 8-bit representation could be encoded in some arbitrary number of ways fewer than 256! To decode, we are talking serious Cray! None of these encodings would be even remotely similar to ASCII, though I concede that some sort of translation table (gasp!) might be contrived. However, I can't see how such a translation table could produce anything having any meaning.

Might the proto-Indo-Europeans have used a unique encoding for each word of their language? I have blessed my Indo-European ancestors at least once a month for many years for taking the advice of their neighbours, my Semitic ancestors, in the matter of the "phonetic" script they adopted rather than the oriental inclination toward ideograms and other mysteries. I'm not sure what script the Tocharians used. A simple, ten thousand-word vocabulary would require 15 bits per word, 16,384! possible encodings, and no way that I know of to contrive an ASCII translation table, so the author couldn't have allowed that as a possibility.

To me, decoding that stretch of DNA would be a project comparable to the Human Genome Project itself.

As for the "deus ex-computing-machina" which killed the copiers, what can I say?

Well, Stan and/or Paul, if you were trying to get a rise, you got a good one out of me.

"Big John" by Doug Larsen raised a wry grin. The last thirteen years of Labor (sic) Government and the "Wages Accord" has decimated the ranks of the labour unions here. Somewhat analogous to the end of the Cold War, I guess.

Over the last three or four years, unions have been devoting more and more of their attention to trying to retain membership. They needn't have worried. We now have a right-wing, Liberal-National coalition government which aims to enact oppressive, anti-worker, anti-union laws as a final solution to opposition to the avaricious, fascist Captains of Industry. My reading of historical precedents is that they will just cause workers to flock back to the union movement and thus enhance the power of the avaricious, communist Shop Stewards of Unions. Common sense seems to be unheard-of among the "born to rule."

Thanks for the stimulus.

JOHN JENKINS

via the Internet

Mr. Levinson replies. . . .

The key difference between John Jenkins's thinking and mine is clearly the size of leap one must make to get from DNA binary code to Indo-European. On closer scrutiny, however, it appears that our thinking may not be that far apart after all.

John says we're "talking serious Cray!" as necessary for the decoding,

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and offers the analogy that "decoding that stretch of DNA would be a project comparable to the Human Genome Project itself." Thus, John and I are at least in agreement that the decoding would be difficult, not impossible.

As to the level of difficulty, the accelerating progress in this area can indeed be seen in "the Human Genome Project itself": At the time I wrote the gist of the novelette (Fall 1994), best estimates for completion of the gene mapping and sequencing were in the decades, or well into the next century. By September 1995, however, Francis Collins, Director of the National Center for Human Genome Research, reported that the sequencing part could well be "99 percent done by 2002 or 2003" ("Rapid Gains Are Reported on Genome," Nicholas Wade, *New York Times,* 28 September 1995, p. A24). Thus, in this area of dramatic breakthroughs especially, what seems like a huge leap today could well be a hop, skip, and a jump tomorrow. And as for the power of the needed computation, "The Copyright Notice Case" establishes early on that the work began at MIT, home of some of the world's most powerful computers; and even the local machines in New York City were "something well beyond the latest commercial chip."

As for John's disbelief that any translation table could produce anything meaningful in Indo-European, and his conjecture about Indo-European and the phonetic alphabet: Proto-Indo-European is indeed renderable via our phonetic alphabet—for example, "five" in English is "penkwe" in PIE, "blood" is "krew," "to burn" is "k'el," "to fly" is "per" (here we see a possible visible link to the English "pursue"), etc. So could Manny Klein (the original researcher in "The Copyright Notice Case") have seen words on the screen that read like PIE, after having worked out a decoding scheme?

Well, why not, if some civilization or intelligence eight thousand or more years ago (a) did indeed communicate in PIE, and (b) had the wherewithal to insert linguistic messages encoded in binary into our DNA. And if they had the power to do (b), then the lethal light would not be "deus ex machina," but an additional program feature of this code.

It's all a question of how far we're willing to "per" in our conjectures. . . .

PAUL LEVINSON, PH.D.

Dear *Analog,*

I was enjoying Charles Sheffield and Jerry Pournelle's *Higher Education* (April 1996) until I encountered a monumental blunder.

The trainees are assigned the problem of calculating their time of rendezvous with an asteroid, assuming a constant acceleration. They "solve" this problem by plotting time against distance for the known motion of the asteroid and for the calculated motion of the spacecraft, and seeing where the two curves cross.

This calculation would be a valid approximation if they intended to bombard the asteroid (but then why bother with turnaround and deceleration, which increase the time?) However, if they plan to survive impact,

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they must match velocities, and that requires a much more sophisticated approach.

If the students were doing this for their own amusement, then this could be interpreted as a demonstration of their ignorance. However, this was presented as an assigned problem, for which the instructors accepted the "solution" as valid. Given the character depicted for the instructor, there should have been pyrotechnics when the incorrect solution was presented.

SHMUEL (SEYMOUR J.) METZ
SysProg & JOAT, Atid/2, Team OS/2, Team PL/I.

It's not really a monumental blunder, but a quite valid approximation. Yes, some fine tuning is needed at the end; but it is *fine tuning, involving numbers small compared to the others in the problem. Students have to do relatively simple problems before they can do very "sophisticated" ones, and an important part of learning to deal with real-world problems is learning when you* can *make meaningful approximations.*

Dear Stan,

I've just finished reading (and enjoying) "Under Pressure" in the April 1996 issue and I will indulge in a detail quibble. Ms. Zettel says Superior took the bodies of the men on the *Edmund Fitzgerald* (and others) straight down to the bottom, a mile below.

I don't know about the rest of the lake, but the *Edmund Fitzgerald,* a 729 foot iron-ore carrier, sank in 535 feet of water. She lies in two pieces in glacial mud and silt. There have been two recent expeditions to survey and photograph the wreck and to raise the ship's bell (to be a memorial ashore).

One was in June of 1994 and the other in June-July of 1995. These surveys were written up in *Sea Technology,* December 1994 and 1995, and make for some fascinating reading. I think *National Geographic* also did an article on one of these dives.

JON GLAZER
PO Box 31
Horse Creek, CA, 96050

Dear Dr. Schmidt,

Having just read "Cat, Mouse" by Brian C. Coad in the April issue, I was struck by a minor coincidence which may amuse the author. Twenty years ago I was a programmer with New York City's tax agency, designing the software to collect the taxes that the Ghost Cat found troublesome. One of the nuisance taxes was an annual levy on juke boxes, mechanical games, etc. Its formal name was the Coin Operated Amusement Device tax. It was, of course, referred to by its acronym.

It's possible that Mr. Coad may still find his name emblazoned on tax stickers all over New York.

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UPCOMING EVENTS Anthony Lewis

4–6 October
ARCHON 20 (St. Louis area SF conference) at Gateway Convention Center & Holiday Inn, Collinsville, Ill. Guests of Honor—Ray Bradbury and Ray Harryhausen; TM—Julius Schwartz; Fan Guest of Honor—Forrest J. Ackerman. Registration : $27 until 27 September. Info: Archon 20, Box 483, Chesterfield, MO 63006. (314) 326-3026. E-mail: zellich@stl-17sima.army.mil

11–13 October
ALBACON (US) '96 (Albany area SF conference) at Howard Johnson Conference Center & Hotel, Albany, N.Y. Guest of Honor—Nancy Kress; Fan Guest of Honor—Shirley Maiewski. Registration: $28 in advance, more at the door. Info: Albacon '96, Box 2085, Albany, NY 12220-0085. (518) 456-5242. E-mail: c.rothman@genie.com

18–20 October
CONTRADICTION 16 (Niagara Falls area SF conference) at Days Inn Fallsview, Niagara Falls, NY. Guest of Honor—Charles Sheffield. Registration: $25 until 23 September, $30 thereafter. Info: Contradiction 16, Box 100-Bridge Station, Niagara Falls, NY 14305.

31 October–3 November
WORLD FANTASY CONVENTION at Hyatt Regency Woodfield, Schaumburg, IL. Guests of Honor—Katherine Kurtz, Joe R. Lansdale, TM—Brian Lumley. Registration: $90 until 1 September, $100 thereafter; $25 supporting. Info: WFC 1996, Box 473, Oak Forest, IL 60452.

28 August–1 September 1997
LONESTARCON 2 (55th World Science Fiction Convention) at San Antonio Convention Center, San Antonio, Texas. Guests of Honor—Algis Budrys and Michael Moorcock; Artist Guest of Honor—Don Maitz; Fan Guest of Honor—Roy Tackett; TM—Neal Barrett, Jr. Registration until 7 July 1996: $95; $25 supporting; children 3-12 $40, children 0-3 FREE (age as of 28 August 1997). This is the SF universe's annual get-together. Professionals and readers from all over the world will be in attendance. Talks, panels, films, fancy dress competition —the works. Info: LoneStarCon 2, Box 27277, Austin, TX 78755-2277. (512) 435-7446 (voice), (512) 435-7747 (fax), lsc2@io.com (e-mail).

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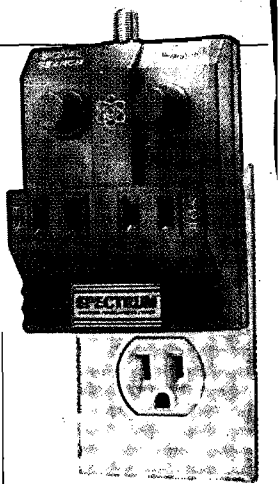
Fifteen years of microelectronic research makes conventional antennas a thing of the past!

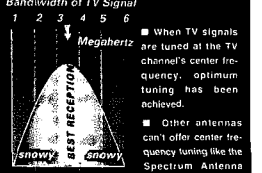
This little box uses your home's electrical wiring to give non-subscribers, cable subscribers and satellite users better TV reception on your local broadcast networks!

by David Evans



Technology corner

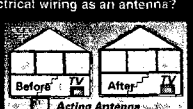
1. Why don't conventional antennas work as well as the Spectrum?



■ When TV signals are tuned at the TV channel's center frequency, optimum tuning has been achieved.

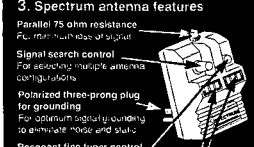
■ Other antennas can't offer center frequency tuning like the Spectrum Antenna can. They only offer such tuning up to the edge of the center frequency. As a result your TV picture remains snowy.

2. How does Spectrum use a home's electrical wiring as an antenna?



Believe it or not, the Spectrum Antenna simply "activates" the giant antenna that already exists in your home. Essentially, it uses all of the wiring throughout your home's walls and ceilings to make an antenna as large as your house for unbelievably clear reception of local broadcasting.

3. Spectrum antenna features


Parallel 75 ohm resistance
For maximum use of signal
Signal search control
For selecting multiple antenna configurations
Polarized three-prong plug for grounding
For optimum signal grounding to eliminate noise and static
Resonant fine tuner control
For dialing in crisp, clear TV stereo reception eliminates ghosting
Dual AC outlets with built-in surge protection
For plugging in additional TV stereo equipment guarding against damage and electrical surges

Until recently, the only convenient way to guarantee great TV reception was to have cable installed or place an antenna on top of your TV. But who wants to pay a monthly cable fee just to get clear reception, or have rabbit-ear antennas that just don't work on all stations? Some people just aren't interested in subscribing to cable. Or they may live in an area where they can't get cable and TV-top antennas aren't powerful enough. And what about those people who have cable or satellite systems but still can't get certain local stations in clearly?

Now, thanks to fifteen years of microelectronics research, a new device has been developed that is so advanced, it actually makes conventional antennas a thing of the past. It's called the Spectrum Universal Antenna/Tuner.

Advanced technology. Just imagine watching TV and seeing a picture so clear that you'd almost swear you were there live. Just plug the Spectrum Antenna into a standard AC outlet and plug your TV into the Spectrum. You can remove the unsightly clutter of traditional TV-top devices gathering more dust than television signals. Get ready for great reception. Your TV will suddenly display a sharp, focused picture thanks to its advanced design "Signal Search" and "Fine Tuner" controls.

Who can use Spectrum?

- ***Cable users-You have cable but you can't get certain local stations in clearly.***
- ***Non-cable users-You don't have cable and want the stations to come in more clearly***
- ***Satellite users-You have a digital satellite system but can't get local stations in clearly***

Uses your home's electrical wiring. The Spectrum Antenna is a highly sophisticated electronic device that connects into a standard wall outlet. The outlet interfaces the Spectrum Antenna with the huge antenna that is your home wiring network. It takes the electrical wiring in your house or apartment and turns it into a multi-tunable, giant TV reception station which will improve your TV's overall tuning capability. The results are incredible. Just think how much power runs through your home's AC wiring system—all that power will be used to receive your local broadcasting signals.

How it works. Broadcast TV signals are sent out from the local broadcast station (ABC, CBS, NBC, etc.). They interface with your home's AC power line system, a huge aerial antenna network of wiring as large as your home itself. When the Spectrum Antenna interfaces with the AC line, the signal is sent to its signal processing circuit. It then processes and separates the signal into 12 of the best antenna configurations. These specially processed signals route themselves into 12 separate circuits. The Spectrum Antenna includes a 12-position rotary tapping switch, the "Signal Switch" control, which gathers twelve of the best antenna configurations.

The "Signal Search" offers varying antenna configurations for the user to select from the best signals of all those being sent. The signal then passes through the Spectrum Antenna's special "Fine Tuner" circuit for producing crisp, clear reception.

Risk-free offer. The Spectrum Universal Antenna/Tuner comes with our exclusive 90-day risk-free home trial and a 90-day manufacturer's warranty. Try it, and if you're not satisfied, return it for a full "No Questions Asked" refund.

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